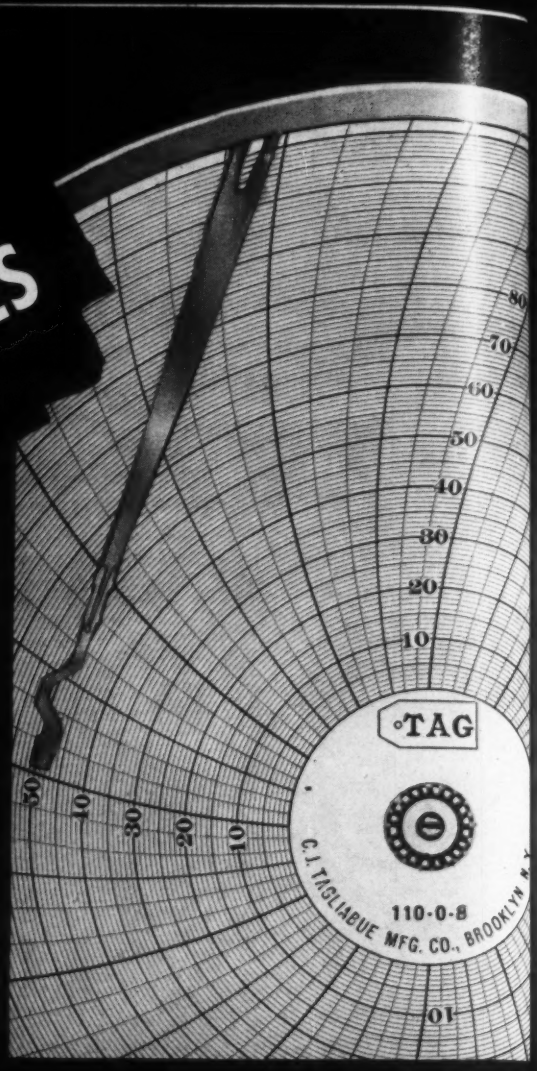
NE 1947
20 No. 6

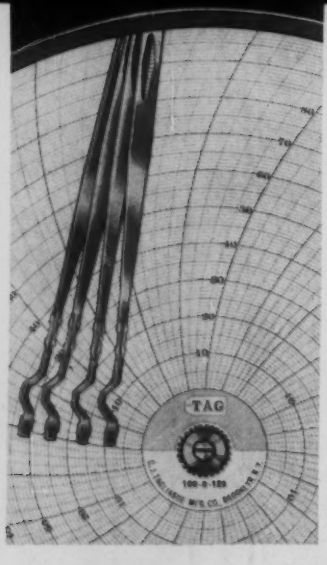
Instruments

E MAGAZINE of MEASUREMENT and CONTROL

Know YOUR TEMPERATURES



TAG



Regardless of what you process or how you process it, you *must* know the temperature fluctuations—to the minute—if you are to turn out a uniform product economically. With a TAG recorder on the job, the chart gives you a clear written statement of the temperature particulars. This record will contribute to product improvement, production speed and reduction of waste.

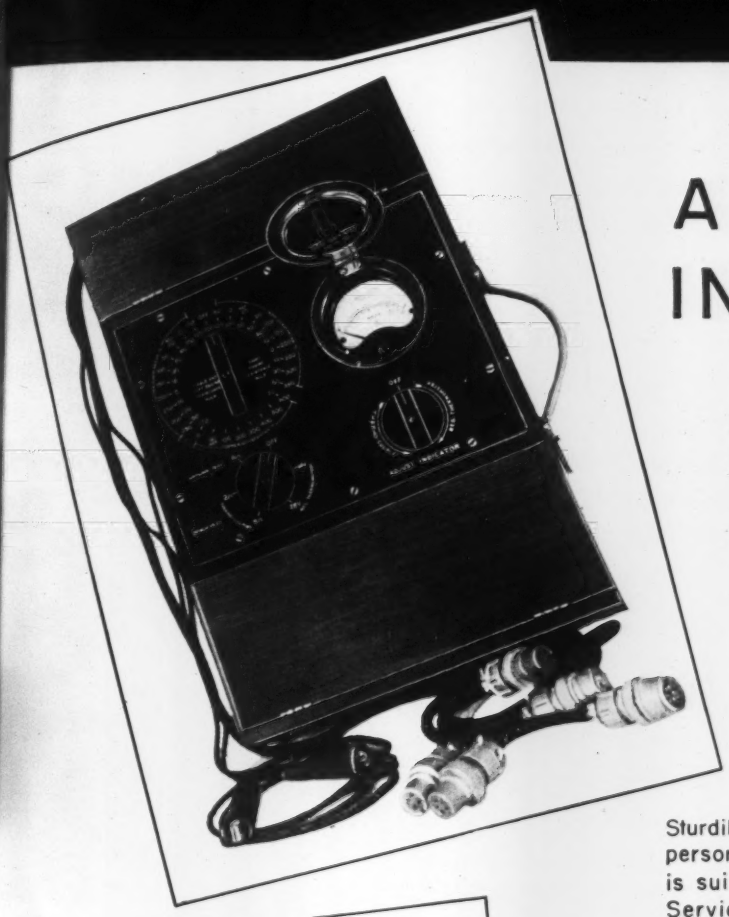
Don't forget that on many applications processing efficiency can definitely be increased by having more than one record per chart. TAG Multi-Pen Recorders are available with 2, 3 or 4 pens for temperature, pressure or a combination of both.

Write for further information on the many possible combinations.

always specify **TAG**

C. J. TAGLIABUE MANUFACTURING CO.

THE LEWIS
Thermometer Tester



A MULTIPLEX INSTRUMENT

FOR TESTING AIRCRAFT TEMPERATURE INDICATORS. BOTH RATIOMETER AND THERMOCOUPLE TYPE.

• • •

MODEL 8ITT5

ON THE BENCH

or

IN THE PLANE

Sturdily constructed and carefully calibrated by skilled personnel to precision standards, this instrument is suitable for use as a Shop Standard or in Field Service. It is entirely portable with self contained batteries and is as easy to operate as a home radio receiver.

To facilitate the calibration and servicing of Aircraft Temperature Indicators, use this TESTER which is made by the leading manufacturer of Aircraft Temperature Instruments — with whom this type of equipment is a SPECIALTY — not a side line.

THE LEWIS ENGINEERING CO.

Specialists in Engine Temperature Measurements

• NAUGATUCK, CONNECTICUT. •

• POTENTIOMETERS • • • • • • SELECTOR SWITCHES • • • • • • • • • THERMOCOUPLES •
• PYROMETERS • • • • • • RESISTANCE THERMOMETERS • • • PROTECTION TUBES •

INSTRUMENTS ON THE MARCH

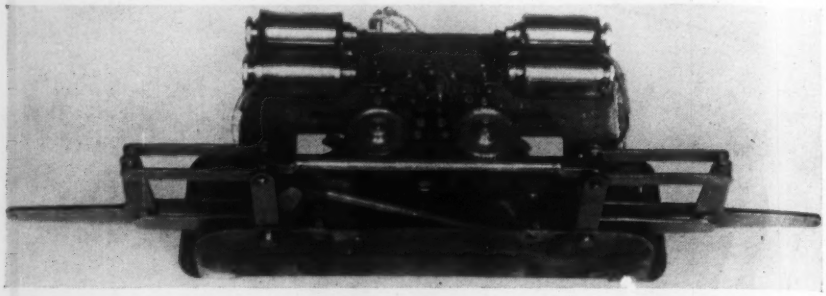
Guided Missiles Are "Instrument-flying" Missiles

WASHINGTON, D. C.—The "Bat," first fully-automatic guided missile successfully used in combat by any nation, is one of several guided missiles developed by the National Bureau of Standards under the sponsorship of the Navy Bureau of Ordnance. Work on guided missiles constituted one of the major war activities of the NBS. The "Robin," the "Pelican" and the "Bat" were brought to a state of completed development. Because of the much greater operational flexibility of the "Bat," however, it was the only one carried into large-scale production and combat use. The program on guided missiles began in the fall of 1940, when the NDRC requested the Bureau to permit the appointment of Dr. Hugh L. Dryden as aerodynamics consultant in connection with a contract for development of a glide bomb capable of being directed to the target by radio remote control utilizing television sighting.

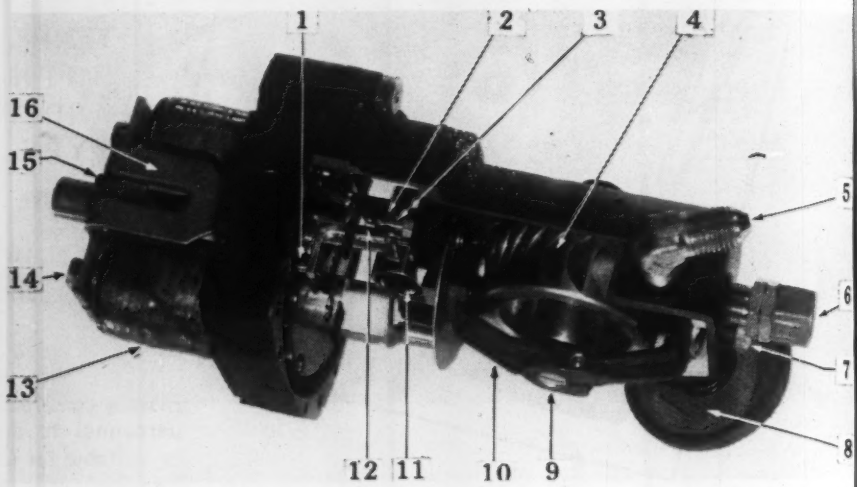
Designed to glide silently at the speed of a fighter plane, with a 1000-pound bomb as cargo, the "Bat" is carried under the wing or fuselage of a Navy fighter or bomber and may be released at a distance as great as 14 miles from the target. Once the crew of the mother plane has located a ship or other target, the missile is set for this particular target and the release button is pushed. From then on the "Bat" automatically follows every maneuver of the target until it eventually strikes home, while the mother plane is free to proceed as its pilot wishes.

In normal use the target is first located by the standard search radar of the mother plane. The plane is then headed toward the target, and the radar transmitter and receiver in the "Bat" are aimed in its direction. Target data from the radar in the missile are displayed on a separate indicator in the mother plane under the control of the operator. After the radar equipment is manually adjusted to the proper conditions, it is switched to automatic tracking, and the missile is released. Echoes from the target are continuously detected by the radar receiver in the missile, and the output supplies correction signals to the flight control units to direct the missile toward the target.

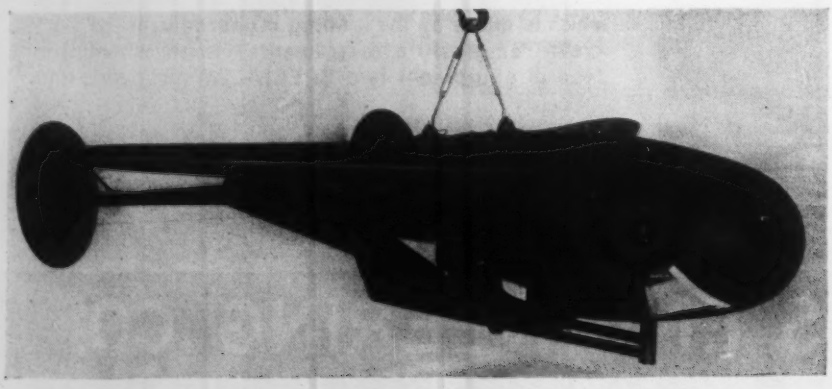
The outstanding features of the "Bat" as a combat weapon are (1)



An early model of the servo unit used in the "Bat" to move the control surfaces.



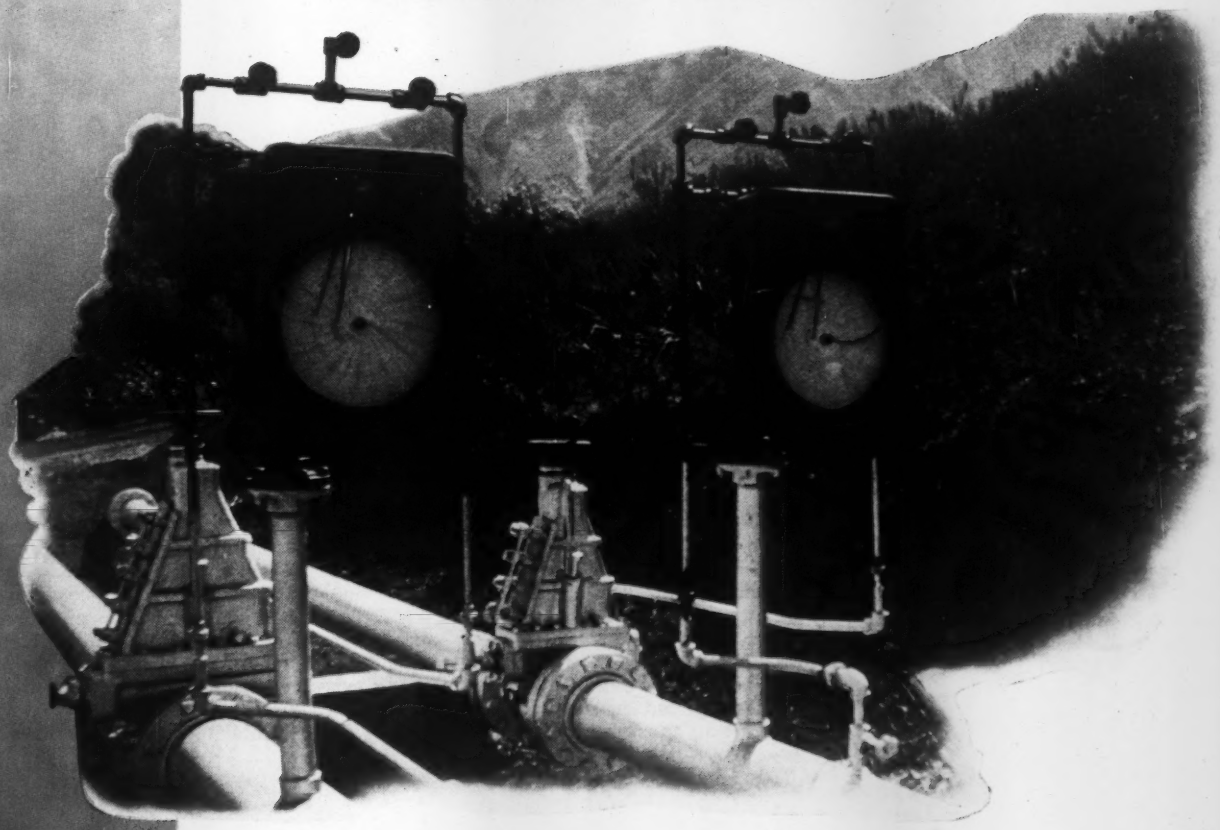
Cutaway view of the gyroscopic stabilizer used in the "Bat." 1. Contact adjustment; 2. Centering spring; 3. Contact arm; 4. Gyro wheel; 5. Air outlet; 6. Regulator; 7. Gimbal pivot; 8. Air intake filter; 9. Gyro wheel axle bearing; 10. Gimbal frame; 11. Damping piston; 12. Contact; 13. Biasing electromagnet; 14. Biasing adjustment; 15. Lever pivot; 16. Biasing lever.

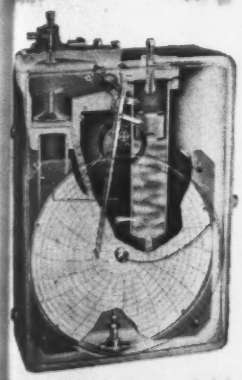


The "Pelican." Note the instrumentation for flight tests. Directly beneath the wing is a 16-mm. Bell and Howell, Type M-4A, gun-sight aiming-point camera. Slightly forward and lower is mounted a 16-mm, Cine Kodak Model E camera. The housing on the nose covers a panel of signal lamps indicating radar controls being applied. The cameras simultaneously photograph the panel and the ground ahead of the glider.

"Bat" shown mounted under the wing of a Navy patrol bomber. Flight characteristics of the carrying plane are only slightly affected by the missile, while flight operations are not in any way altered.

Where Low-Cost Accuracy Saves Time and Labor





OUT IN THE FIELD, where maintenance is infrequent and tough conditions call for dependable measurement, you'll find that METRIC American Orifice Meters pay off in low-cost accuracy.

When adjustment becomes necessary, simple, functional design makes this quick and easy. Only three tools — screw driver, wrench and pliers are needed.

The fewest possible moving parts go into METRIC American design — only one part between the mercury and the chart record. The float is simply constructed — placed on the low side to make calibration easy. Meters can be cleaned without upsetting adjustment — adjusted without interference with working parts.

METRIC American's low-cost accuracy and easy-to-service design, proved the world over, are the result of years of measurement engineering.

Technical literature, on Indicating, Recording or Integrating Flowmeters, Pressure Regulators, Liquid Level and Flow Controllers will be mailed on request.

AMERICAN METER COMPANY

Albany · Atlanta · Baltimore · Birmingham · Boston
Chicago · Dallas · Denver · Erie · Houston · Joliet
Kansas City · Los Angeles · New York · Orlando
Philadelphia · Pittsburgh · San Francisco · Tulsa

FLOW RATE METER ELIMINATES "BUBBLE COUNTING"

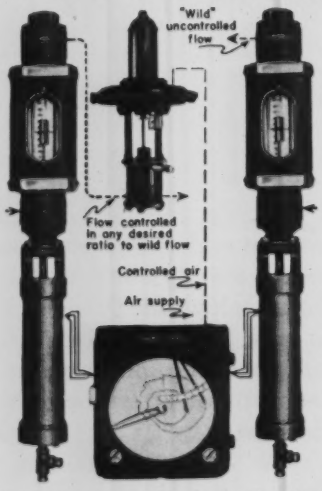
This compact flow meter is the answer to purge line (Bubbler) control installation.

. . true purge rate indication
. . . easily and neatly panel mounted singly or in multiple, requires a minimum of space.
. . furnished with or without needle control valve.

$9.00 per unit, without control valve (lower price when purchased in quantity).

Write for catalog 31

AUTOMATIC FLOW RATIO CONTROL



The proportioning of fluids, passing through two or more different pipe lines, becomes really practical with the FLOWRATOR variable area type flow meter. For satisfactory ratio control, the linear calibration scale of FLOWRATOR instruments is a necessity.

Send for catalog 50 which describes how difficult proportional control problems can become easy and also reasonable in price.

FLOWRATOR
TRADEMARK
FISCHER & PORTER CO.
DEPT. 7R-5C HATBORO, PA.

long range, which provides the ability to attack heavily armed targets with accuracy from outside the anti-aircraft range; (2) improved accuracy, a result of the self-homing feature; (3) low angle of flight, which reduces high altitude problems; (4) high pay load; and (5) self-guidance after release, permitting the carrying plane to maneuver as desired.

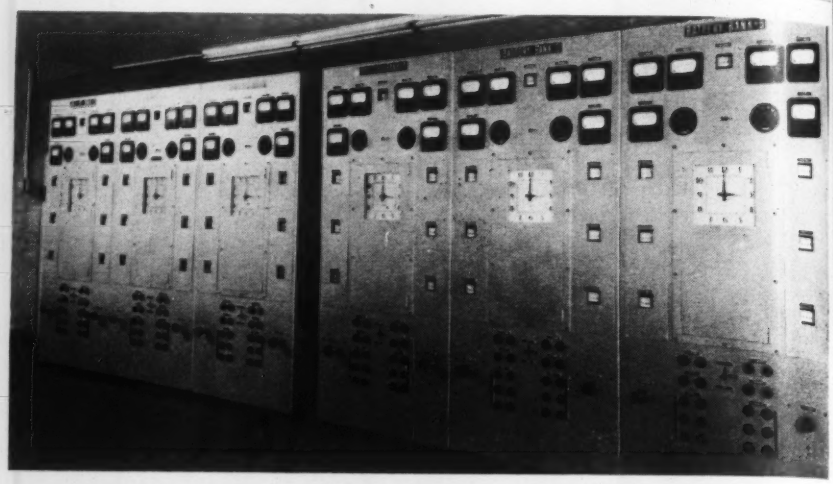


Fig. 1. Front view of the control cabinets for the six cycling units. On each cabinet are the follower clock, and the voltmeters, ammeters, cycle counters and ampere-hour meters (along the top and sides). In the center of each cabinet is the program-controller panel.

Cycle-testing Laboratory for Aircraft Batteries

WASHINGTON, D. C.—A new laboratory for battery research has been constructed at the National Bureau of Standards with the coöperation of the Bureau of Aeronautics, Navy Department. Equipped with completely automatic controls for cycling batteries, this laboratory offers a unique method of testing batteries under conditions simulating those met in practice.

The equipment provides for discharging the batteries through constant resistance and recharging them either at constant potential or at constant current, as desired. The cycling may be performed automatically for batteries under conditions of room temperature, extreme heat, sub-zero temperatures, and "flight" vibration.

Six similar cycling units have been

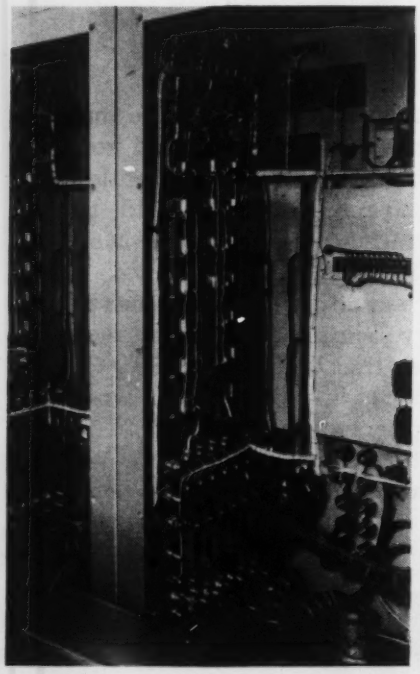


Fig. 2. Back view of part of the control cabinets for the six cycling units. On the inside of each cabinet are the sequence relays mounted in two horizontal rows near the top, the contactors in the middle, and the shunts in two horizontal rows near the bottom of the wall.

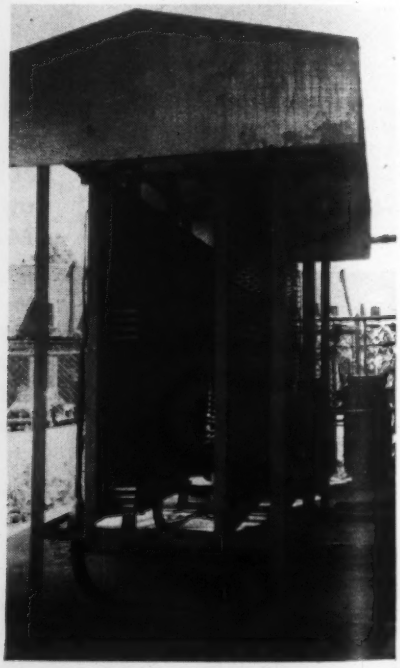


Fig. 3. Out-of-doors load resistor (with the housing removed). Natural circulation cools the resistors, which utilize Nichrome ribbon wire for high rates of discharge and helical coils of Nichrome wire for intermediate and low rates of discharge and for charging at constant current.

This ILLUSTRATED TABLE OF CONTENTS MAKES THE BROWN BUYERS' GUIDE *Easy-to-use*

"Really easy to use," is what purchasing agents, maintenance men, foremen and engineers all say about the Brown Pyrometer Supplies Buyers' Guide. This 40-page *free* book reduces the complex subject of thermocouples, lead wire, etc. to A, B, C.

The illustrated Table of Contents shows you in picture form where to find any item without "fuss or bother."

Each page has a simplified drawing and informative tables as well as instructions on "How to Order" and "Ordering Example."

You can't go wrong. This book takes the mystery out of ordering pyrometer supplies.

Every department ordering or specifying pyrometer supplies should have a copy.

For your *free* copy, ask for Buyers' Guide No. 100-1. Write or wire the Pyrometer Supplies Department.

The Brown Instrument Company
4482 Wayne Avenue Philadelphia 44, Pa.
DIVISION OF
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
Offices in all principal cities
SUBSIDIARY COMPANIES IN TORONTO • LONDON
STOCKHOLM • AMSTERDAM • BRUSSELS

MH BROWN
PYROMETER SUPPLIES

MAIL THIS COUPON FOR YOUR FREE COPY

THE BROWN INSTRUMENT COMPANY, Pyrometer Supplies Department
4482 Wayne Ave., Philadelphia 44, Pa.

Gentlemen:
Without obligation, please send me copy of "Pyrometer Supplies Buyers' Guide No. 100-1."

Name ..... Title .....
Company .....
Address .....
City ..... Zone ..... State .....

HELICOID SCORES AGAIN!

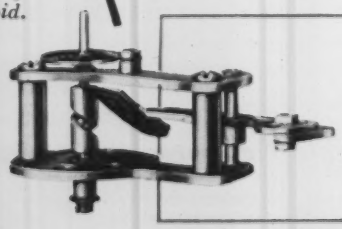
• The new ACALOY case is a high-compression molded aluminum alloy. Treated by a patented process to prevent corrosion. Durable baked-on finish. Withstands 1200 hours salt spray test.

Weather-proof. Neoprene sealing gasket. 18-8 stainless steel snap ring. Greater strength — less weight. It's another Helicoid exclusive.

With back flange for wall mounting, or without flange for stem mounting. Safety blow-out discs optional.

Specify Helicoid gages in the new ACALOY case. They will reduce your maintenance expense. . . . the Helicoid movement, with no gear teeth to wear out, lasts many times longer.

Send for the new catalog that tells the complete story of Helicoid.



Only Helicoid pressure gages have the Helicoid movement.

ACCO

TRADE MARK

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE
Bridgeport 2, Connecticut

installed, each operated ind ently a master electric clock. Eac unit co sists essentially of a contr cabin two motor-generator sets, a the ne essary resistors. From one six volt batteries may be cycle on ea unit. Each control cabinet ntains program machine for utomat cycling, sequence relays, ntact (aircraft type), and a cop er oxi rectifier which supplies 24-vo d.c. operating the switching devices.

Each program machine carries thr endless tapes which pass under co tact fingers and control six progra circuits:

Circuit 1. (a) Starts motor-genera sets and connects batteries in parallel constant potential charge. (b) Stops mot generator sets and disconnects batteries.

Circuit 2. (a) Connects batteries series on constant current charge. Disconnects batteries.

Circuit 3. (a) Connects batteries series on high-rate discharge. (b) Disc nects batteries.

Circuit 4. (a) Connects batteries series on intermediate rate or low rat discharge. (b) Disconnects batteries.

Circuit 5. (a) Short-circuits a por of the charging resistor for constant curr charging at normal rate. (b) Opens sho circuit on resistor for finishing rate.

Circuit 6. (a) Operates cycle coun (b) Disconnects one motor-generator after peak load is passed when charg at constant potential.

The control circuits in any progra machine can be used independently concurrently in any order dependi upon the program which has been s up. Toggle switches in the machin provide for switching to manual oper tion when desired, and skip pins whi lift the contact fingers provide f omitting the program for specified i tervals of time. Interlocking rela prevent the connection of batteries series and parallel at the same time the event of an error in manual switc ing or a failure of a sequence rela

The general plan of the laborato was developed by C. L. Snyder, Na tional Bureau of Standards, with th cooperation of Lt. Kenneth Dawkins the Bureau of Aeronautics. Engineer of the Standard Electric Time Compan worked out the details for the aut matic controls and constructed th control cabinets.

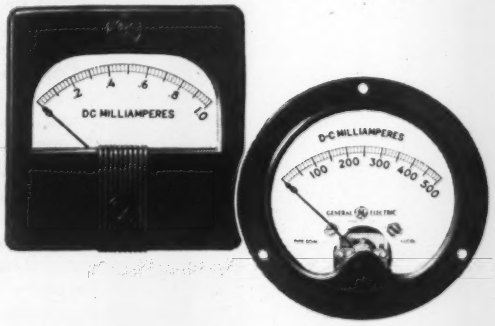
Pocket-size Adhesion Tester

NEW YORK CITY.—Most instru ments designed to measure adhesion o organic coatings are restricted to labo ratory use on specimen panels. It i common practice, in production or i the field, to estimate adhesion of pain films on parts by the finger-nail o knife. To fill the need for a quantitativ method embodied in a measuring in strument easily carried to the work and suitable for parts too large to handle i the laboratory, a pocket-type adhesion tester has been designed by Bell Tele phone Laboratories, it was disclosed by R. J. Phair, of Bell Labs' Chemical Lab oratories. Small enough to be held easily in the hand, the instrument meas

FOR YOUR CONVENIENCE . . .

PANEL INSTRUMENTS NOW AVAILABLE

Right Off the Shelf!



To supply you with instruments *at the time you need them,* General Electric is accumulating a stock of 3½-inch, round and rectangular panel instruments in all the popular ratings. No waiting for delayed shipments . . . just place your order and they're on the way to you.

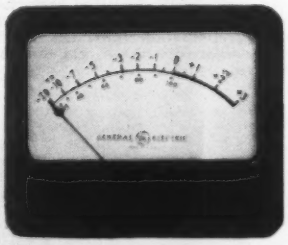
NEW DISCOUNT BENEFITS

Also, more favorable prices, made possible by new discount benefits, are now available to you when ordering these standard types and ratings.

Included in these stocks of compact, high-quality G-E instruments are ammeters, voltmeters, milliammeters, and microammeters . . . instruments for applications where AVAILABILITY counts.

INSTRUMENTS MADE TO ORDER

In addition, General Electric is equipped to solve your individual instrument problems. Requests are welcomed for special, made-to-order instruments to be incorporated in your product where standard models cannot be used. For further information contact your General Electric representative or write to *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*



VU METERS are now normally stocked in the following styles: non-illuminated, no mask, "A" scale; illuminated, no mask, "A" or "B" scale. Black covers are standard; gray covers can be furnished.

HEADQUARTERS FOR MEASUREMENTS

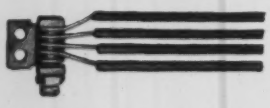
GENERAL ELECTRIC

602-106

BRADLEY

COPPER OXIDE RECTIFIERS

IMPROVE INSTRUMENTS AT LOW COST



Vacuum-processed, gold-coated Bradley instrument rectifiers increase equipment efficiency. Especially designed for use where stability and permanence of calibration are important, "Coprox" rectifiers meet the most exacting requirements. Yet they cost no more than ordinary rectifiers — in most cases, less.

Temperature error is exceptionally low with Bradley rectifiers. Aging is practically nil. Pre-soldered leads. Rating of CX-2E series up to 4.5 volts A. C., 3 volts and 5 milliamperes D. C.

Illustrated literature, available on request, shows more models of copper oxide rectifiers, plus a line of selenium rectifiers and photocells. Write for "The Bradley Line."

BRADLEY LABORATORIES, INC.

82 Meadow St. New Haven 10, Conn.

ures adhesion by determining the pressure that has to be applied to a scratching element to make it expose the base material under the finish. The scratching element is mounted at the end of a short cylindrical rod and is pressed by a spring against the surface tested. A threaded sleeve controls the pressure exerted by the spring by squeezing it between the end of the sleeve and a shoulder on the rod. Graduations on the outer end of the rod, which projects through the threaded sleeve, indicate the pressure applied. These parts are supported by a housing which has rollers on which the instrument rides over the surface of the finish. When both rollers are firmly pressed against a flat surface the spring pressure is transmitted directly through the scratching element to the test film.

The scratching element is a steel disk 0.256″ O.D. and 0.0625″ thick. The periphery of the disk is smoothly rounded to a radius of 0.0312″, hardened, highly-buffed and chromium-plated.

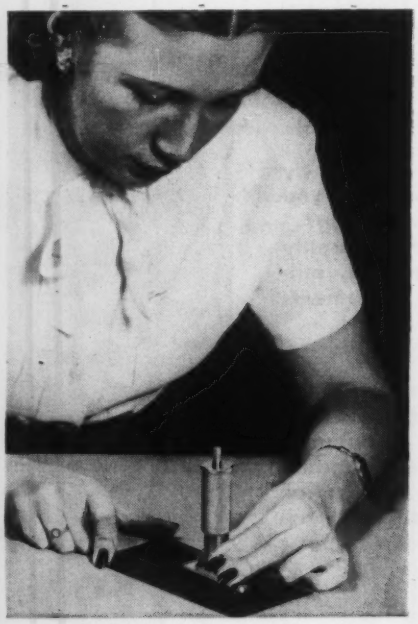
In use the instrument is set for minimum pressure, pressed firmly against the coating to be measured so that both rollers are in contact with it and then pushed with a slow, steady motion over the film. This process is repeated, with increasing pressure obtained by turning the threaded outer sleeve an arbitrary amount, until the film fails. This occurs when the film is removed by the scratching disk and the base surface is exposed. The adhesional level is then read from the scale on the upper end of the graduated rod. Each division represents about a 500-gram increment and the scale range is 500 to 5,000 grams of from poor to excellent adhesion.

"X-raying Oil Fields" in the Laboratory

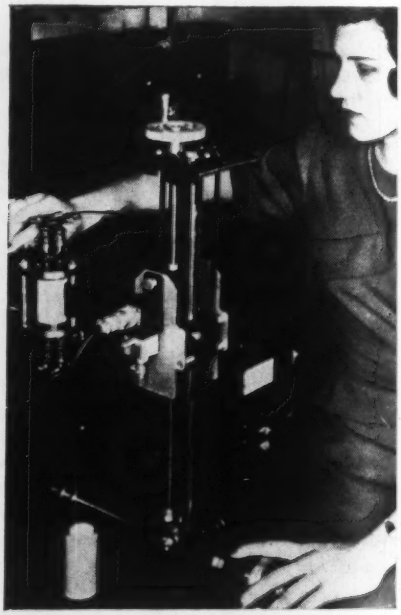
[SEE COVER PHOTO]

HARMARVILLE, Pa.—A method of x-raying oil fields by remote operation from its research laboratories has been developed by Gulf Oil Corp. and will soon be put to use to increase the yield of the world's petroleum reservoirs.

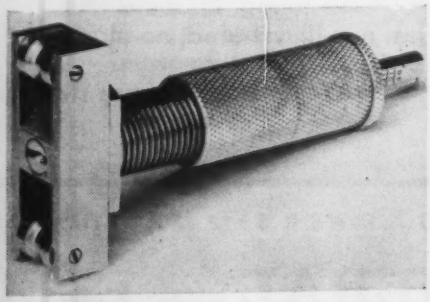
The new instrument method helps solve the riddle of how oil flows through the sand and rocks under any particular field, and how it is affected by underground water and gas. Since x-raying oil fields at their sites would be impractical, developers of the new method took the opposite course and brought the fields to the laboratory. Experiments were begun with



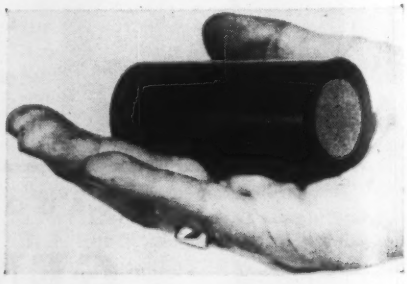
This pocket tester, shown here in a laboratory, can be used in the field, on parts too large to be brought to a laboratory.



A sample of oil-field rock being mounted in the x-ray permeability-saturation determination apparatus, where it will be injected with oil, gas and water, and then x-rayed.



Adhesion of paints and other finishes is measured with this pocket tester.



Rock sample (cast in Bakelite) brought from an oil field to be x-rayed.

This New TRADEMARK

Means Instruments Custom Designed for Your Industry

AVION

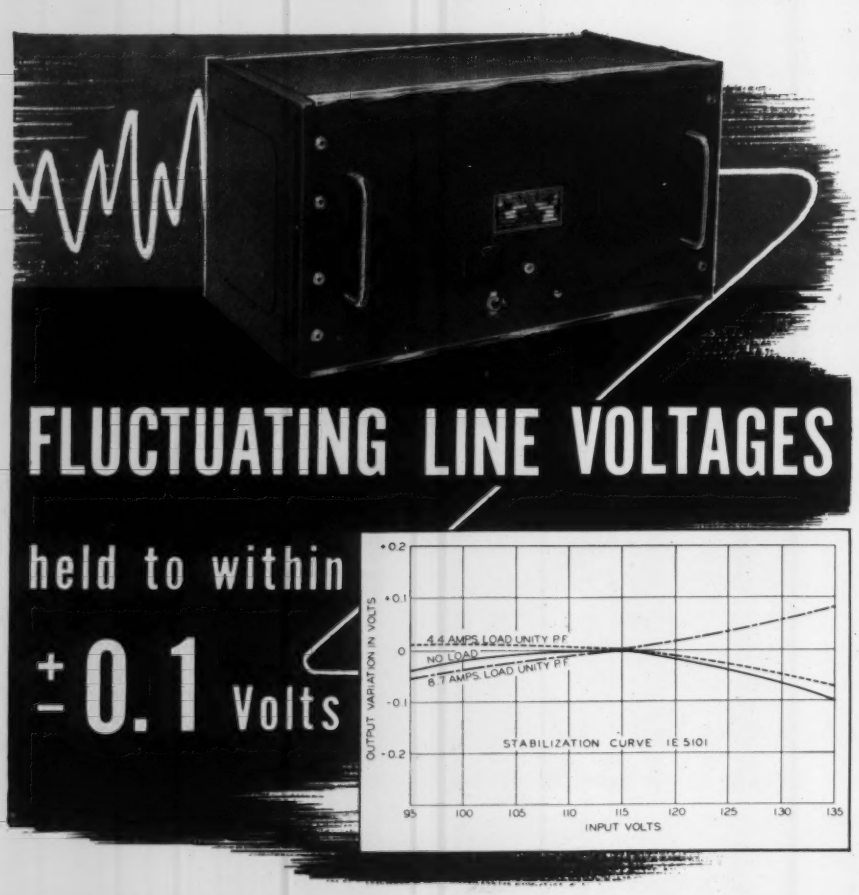
The future of development depends upon control . . . control provided through instruments of special design.

Avion engineers furnish your industry with these instruments. In designing and building servo controls, computers, measuring devices, gyroscopes and optical instruments, Avion equipment for laboratory, production testing and control assures continued progress.

By helping to solve your problems and working with you on your plans, Avion often provides improved products at reduced cost.

AVION INSTRUMENT CORPORATION

15 MOORE STREET • NEW YORK 4, N. Y.



STABILINE *Instantaneous Electronic* VOLTAGE REGULATOR

With a STABILINE type IE Voltage Regulator in the power line, electrical apparatus is assured of constant voltage. Regardless of line changes — rapid fluctuations or slow variations — the delivered voltage is held to within ± 0.1 volts of the preset value. Typical are the performance curves of type IE5101. Although the input line voltage may vary from 95 to 135 volts, the preset output voltage is stabilized to well within ± 0.1 volts.

Fluctuating line voltage is just one problem of many in maintaining constant voltage. Others are varying frequencies, loads, power factors together with waveform distortion. An investigation of the STABILINE type IE will show, in addition to stabilization of ± 0.1 volts, such characteristics as . . . waveform distortion never exceeding 3 percent . . . regulation to within ± 0.15 volts for any load current change or load power factor change from lagging .5 to leading .9.

Write Superior Electric, 1006 Laurel Street, For Information and Literature

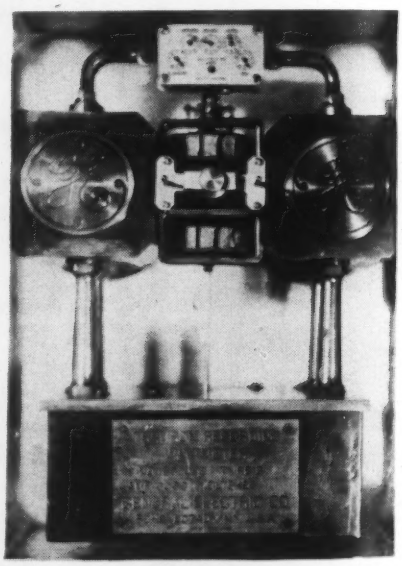
THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

Powerstat Variable Transformers • Voltbox A C Power Supply • Stabiline Voltage Regulators.

columns of sand 10 feet high taken from the oil wells. Today a 3" x 1" core from the drill hole is subjected to artificial pressures and saturations of oil, gas, and water. The progress of these fluids in the core is measured by an x-ray instrument named Apparatus for Determining Permeability-Saturation. An opaque tracer is mixed with the liquid or gas. (This principle is similar to taking x-rays of the digestive tract after feeding with opaque barium compounds.) First step is to establish a basis for comparison by studies of the core at 100% and at zero saturation. Then flow experiments, reproducing conditions which might be created by various recovery methods are made. Effects of gravity, capillary attraction, and the amounts of oil, gas and water already in the sand are charted.

Correlation of data permits determining how natural pressure, or artificial gas injection, or water flooding, will move oil through various strata toward well shafts. Operating methods can be planned accordingly and the extent of the yield can be forecast.

Permeability-saturation determination by x-ray represents an extension of the Electrolytic Model Oil Field technique developed by Gulf Research (see *Instruments*, Oct. 1946, page 599) for predicting GENERALIZED oil field behavior and guiding placement of wells: it analyzes LOCAL flow conditions, both existing and possible, in specific fields.



FORTY YEARS YOUNG. For this G-E "Type G" watthour meter, life begins at forty. It has operated continuously without repairs for forty years at the Central Guanica, a large sugar refinery in Aguadillo, Puerto Rico. E. R. Ball, G-E Service Engineer who visited the plant recently, reports that on test it retained its original accuracy. A mechanical inspection revealed no visible wear of operating parts and none of the corrosion usually associated with the heat and high humidity of the area.

EDITORIAL By M. F. BEHAR

Automatize Quality Control!

BETTER uniformity of products, minimization of rejects and improved quality of products were listed nearly a quarter-century ago among the aims of Instrumentation.

"So what? — Everybody in industry has these aims and your so-called new science is not needed," scoffed most listeners, some of them adding that quality would be improved in the future, as it was then, with the aid of instruments in their laboratories—NOT with the aid of instruments on the processes.

"Don't enrage our skilled old operators by suggesting that automatic controllers be installed and don't spoil the new operators we're training," was a frequent parting shot by Chief Chemists, Chief Metallurgists, Chief Inspectors, and others whose duties included (unsystematically) those of the modern Director of Quality Control.

The FACT that organization charts of modern industries include a Director of Quality Control bears witness to the value of Instrumentation (the science) and of instrumentation (the devices).

Were it not for this science—organized knowledge of measurement and control laws, principles, methods and means common to ALL industries and applicable to all processes—there would be no Quality Control in the modern sense; responsibility for product quality would still fall on different specialists: here a steel metallurgist, there a soap chemist; here a rubber technologist, there a dairyman; here a ceramist, there a paper chemist; here a textile specialist, there a brewmaster; men whose only common ground would be grammar or gardening or guns or golf.

The foregoing is a strong assertion. Some subscribers may doubt it; most will accept it; a few old subscribers could prove its truth better than we could, by case histories with many statistics covering their last fifteen years' production, man-hours per unit, percents of rejects, specific improvements, etc. We shall try to prove it by a general (rather than a "case") history—not a history of the whole Instrumentation movement but only of its Quality Control aspects—not a dry history but an informal tabloid history with Instrumentation laws, principles or ideas condensed into slogans or dogmas.

1. Antecedents: "Don't Guess, Measure!" We stand on the shoulders of giants: 18th-century physicists and chemists, and 19th-century metrologists, who developed systems of weights and measures, adopted reference points, established units and created dimensional analysis. All honor to them!

2. "Conquer the Variables!" Likewise, long before this early slogan was coined, the aim it expresses was being striven for, often with more zeal than science, by pioneer users of instruments in various industries.

3. "Reduce Variables to Measurables by Isolating Them." With the enunciation of this Instrumentation principle came also the first classification of measurables into (1) processing conditions such as temperature, pressure, flow-rate, duration, etc., (2) physical and chemical properties of the product, (3) composition of the product, (4) simple magnitudes and (5) simple quantities. METHODS of measurement were likewise analyzed and two sets of classification systems established: (1) for classifying MEASURING methods; (2) for the methods of measuring each MEASURABLE. Characteristics (advantages and limitations) were tabulated, making the new science USABLE.

4. "If It's Testable It's Incontestable." The quality of a product is not measurable *per se* but its composition and properties are measurable. The correct use of the right instruments being encouraged, "quality" became definable in more fields, specifications were simplified and the design of new special testing instruments completed the happy circle.

5. "If You Can Measure It You Can Control It—or Its Effects." (last three words refer to the weather, etc.) This principle was not new as regards processing conditions: our grandfathers controlled pressures, temperatures and durations, but its universality was doubted. It seemed impracticable (except in the simplest cases) to control properties by using the readings of the property-measuring or concentration-measuring instrument to adjust the instruments which measured and controlled the processing conditions. This was about twenty years ago when laboratories made the tests and when batch processes were the rule.

6. "Measure Continuously and Make Your Processes Continuous." This idea was—and still is—one of Instrumentation's most precious gifts, for it was reinforced by classifications of primary elements, of intermediate elements, of indications, of records, of relays and of servos. This gold-mine of ideas did not neglect the useful possibilities of discontinuous methods.

7. "If You Can Control Manually You Should Control Automatically." Our grandfathers practiced this dictum in a few cases as they did No. 5. Likewise, too many engineers doubted (and still doubt) its applicability to the automatic control of properties of products except in the simplest cases. Descriptions of successful applications were widely circulated, therefore, as object lessons. Again, publicizing the possibilities of discontinuous methods aroused the interest of more industries.

8. "Modes of Control" was an expression coined just twenty years ago to classify and evaluate the many different behaviors displayed by various types of automatic controllers when controlling the numerous types AND SIZES of applications (machines, processes, etc.). Spreading the idea that an automatic controller can behave like a human being induced quality-control executives to look into subjects previously studied only by control-system inventors and builders.

9. "Design Controllability Into Processing Units." Scorned when proposed in 1930, this idea later spread at geometric expansion, to its apotheosis in Manhattan Project plant designs where quality control—purity control to unbelievably small tolerances — is automatized. It CAN be done!

10. "Time Is Automatic Control's Friend and Foe." Around this slogan was formulated a science within a science, treating of lags, delays, oscillations, flywheel effects, reservoir effects, feedback loops, etc.—too technical for a tabloid history—which proved itself applicable to all industries.

11. "Robot Analyzers" and *"The Manless Factory."* Obstructing the applications of all sciences has been, and is, the "my-problem-is-different" attitude. Nearly all chemists accepted, soon or late, the idea that the properties and composition of the effluent product can be exactly pre-determined by controlling the process conditions. But most chemists (and many chemical engineers) qualified as a wild dream the Instrumentation doctrine that the delicate, humanly-manipulated, weekly or daily tests of products in quality-control laboratories could be automatized in such manner that the test results would command (or "reset") the process-condition controllers. Many still think it a wild dream, but their ranks began to dwindle in 1940 when analyzing methods—both actual and possible—were classified and evaluated with the specific purpose of bringing to light the possibilities of "telemetering" the quality-control laboratory so as to command the process-condition controllers.[1] Further inroads on the skeptics followed the 1942 American Chemical Society session on the manless factory.[2] Of course it is not always obvious or easy. Here are two tough problems:

I.—Food Products. Here, Quality is made up of elusive "qualities" as well as measurable properties. Food-product chemists could adopt the indirect or collateral method of automatic control. The dairy industry furnishes a good example: The quality of non-homogenized pasteurized milk depends chiefly on measurable properties such as the cream line and the bacteria count. These properties depend on the temperature and duration of the pasteurization process. Health authorities and dairymen act as the "master controller" whose "signals" in the shape of codes "command" the control instruments on pasteurizers.

II.—The Blast Furnace. At present, pig-iron quality is determined by time-consuming analyses and tests; and smelting process conditions are not fully controlled because all the interdependent variables have not yet been reduced to isolated measurables. So it usually takes *years* for the laboratory "signal" to accomplish important process "resets" such as ordering changes in furnace dimensions to alter the durations of the processes in the various zones, ordering changes in proportions of raw materials, etc. Even minor "resets" during runs involve "characteristic times" of days or weeks. Therefore it seems rash to propose instruments which will instantly measure the quality of pig iron as it is tapped (even before: in the hearth) by measuring its composition and its future properties as a solid—and which will transmit their sets of findings to robot-brain instruments which will command the smelting-process condition controllers. Yes, rash, but reasonable!

Yesterday's lab tester or analyzer should be the plant instrument of TODAY, not of a remote to-morrow.

(1) INSTRUMENTS, March 1940, pages 63, 84-85.

(2) Official title was "Stepping Up the American Chemist's War Effort Through Instrumentation" but the actual theme was "The Manless Factory, with Particular Reference to Minimizing Lags and Delays." It was not published by the ACS at the time. It should be published.

The Shadowgraph Recording Method

By D. L. SUPERNAW, Ordnance Research Laboratory, The Pennsylvania State College

Introduction

In all fields of research and development it is necessary to have some method for recording information derived from or common to any observation or experimental operation. The manual tabulation of observations at regular times, or event intervals, may be satisfactory for some types of work, but a continuous record is more desirable and often absolutely necessary.

Several factors govern the selection of a recorder for any project:

1. Characteristics of each function to be recorded.
2. Number of functions to be recorded.
3. Duration of recording time.
4. Physical conditions common to operations under which the recorder must operate.
5. Available power for running the recorder.
6. Available space for the recorder and associated equipment.

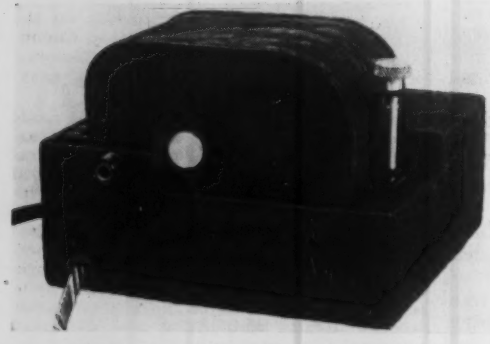


Fig. 1. Seven-element Shadowgraph Recorder.

For work in the laboratory, the first three factors generally determine the selection of a recorder. Equipment should be chosen which will transfer the desired information to a continuous record with a minimum amount of loading imposed by the recorder input on the source under observation. Numerous recorders are available on the market and, if the requirements are not unusual, the only problem is to select the most desirable type of instrument and possible associated equipment.

Field operations where available space is not a problem may include factors 4 and 5. The recorders should be rugged enough to withstand normal handling and service in the field. Batteries and converters or a portable power plant offer a possible solution for a-c. power supply requirements if a constant frequency is not necessary. Standard recorders with d-c. drive motors may be better suited to this general class of operation.

When all six factors must be considered and the available space is exceptionally small, the problem of recording can be serious and the design and building of suitable instruments may be a major contribution to the progress of a particular project.

The two recorders described in this article fall in this group. They were designed for use in guided missiles where the total available space was extremely small and where it was not possible to use conventional recording methods.

The design of the Shadowgraph recorder originated as a method for meeting these problems. The results were so satisfactory that this method of recording can be used to advantage where its compactness is not necessarily a contributing factor. The specific requirements on the first instrument are discussed in some detail as they help to amplify the conditions which led to its particular design, although the second recorder which includes all the basic principles of the first is much better suited to fabrication and is recommended where this type of instrument can be used.

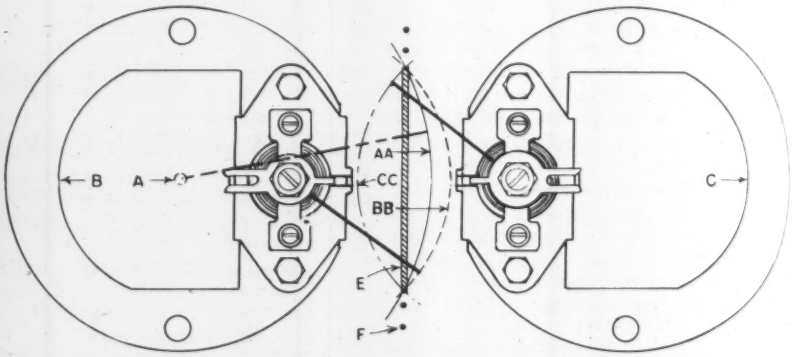


Fig. 2. Arrangement of instruments and slot (actual size). A—Location of pivot of pressure-gage pointer. AA—Path at end of pressure-gage pointer. B—Voltmeter. BB—Path at end of pointer of voltmeter B. C—Voltmeter. CC—Path at end of pointer of voltmeter C. E—Slot forming chord common to path of the three instruments. F—Four impulse ports, two on each side.

The Seven-element Recorder

The first of the two recorders to be described (Fig. 1) had to be designed within maximum over-all dimensions of 5" × 5" × 3¾". Over a period of five minutes, it was desired to record four "impulse" or "off-on" types of information, one pressure variation from 0 to 25 lbs./in.^{2}, and two separate differential voltage variations of 3-0-3 volts d.c. across an 1800-ohm load. An additional complication in recording these two sources of voltage was keeping the shunting effect of the recorder input higher in resistance than 25,000 ohms. The functioning of the equipment under observation would have been affected by greater loads.

Fortunately, the rate of change in voltage values was slow enough to permit the use of any recording element with a response equal to that of a voltmeter. The rate of change in pressure, likewise, was slow: it did not exceed 10 lbs./in^2 per second.

In normal operations, the recorder would not be subject to excessive vibration or shock, but it was desirable to construct the instrument to withstand operating conditions similar to that experienced on mobile instruments used on road equipment.

With these general specifications established, it was necessary to devise some method of recording that could be completely incorporated in a housing 5" × 5" × 3¾". All of the conventional methods considered were rejected either because of their excessive size or because they required auxiliary equipment such as amplifiers.

Since the visual observation of sensitive voltmeters (10,000 ohms per volt) had constituted a suitable check on simulated "runs" in the laboratory, a moving picture of the two voltmeters and the pressure gage would give a satisfactory record on actual runs. Here again we were limited by the necessary distances between all of the elements in the optical system as well as by the size of the mechanical elements. It was still desirable to take the information from the voltmeters and pressure gage photographically, as this imposed no load on these instruments and the record would be correct within the accuracy of the instruments. A system was devised whereby moving sensitive paper could be exposed through a mechanical slot by a point source of light so that any obstruction between the light and the slot would cast a shadow and leave unexposed a line on the sensitive paper. By arranging the voltmeters and pressure gage so that the slot formed a chord com-

mon to the circular paths at the ends of their indicating pointers, it is obvious that the pointers would cast a shadow on the sensitive paper. These shadows would be somewhere within the limits of the length of the slot, depending on the position of the pointers, and would appear as separate variable traces on the developed paper.

This arrangement, as shown in Fig. 2, was made possible by removing the two voltmeter "movements" [mechanisms] from their cases, removing their scales, and rotating the moving-coil assembly 180°. Triplett 2" "Type 221T" 100-0-100 microammeters were used, as their moving-coil assemblies are in one piece and held in position by two screws which secure them to their permanent-magnet fields. It is only necessary to take out the screws, carefully remove the moving-coil assembly, and replace it 180° from its original position. A 30,000-ohm series resistor was used to give the 3-0-3 volt scale.

The Bourdon tube pressure gage is not shown. Its "movement" is mounted inverted directly above Voltmeter B with the pivot of its pointer at the location indicated by A. Since the full sweep of gage pointer is not used, a gage must be selected which has the desired range over the number of degrees required to sweep the slot.

Two ports at each end of the slot act as apertures through which the sensitive paper can be exposed by individual light sources to give the four "impulse" or "off-on" records. The location of the impulse traces identifies them, but the three variable traces require individual identification.This was made possible for the pressure-gage trace by reason of its characteristics; different widths of traces for the two voltmeters were obtained by turning one voltmeter pointer on edge while the other was left with its wide surface parallel to the sensitive paper: the different widths of the resultant shadows gave the desired difference.

In Fig. 3 we can see the arrangement of these various components less the drive and reduction gear. The slot O and four ports are in a straight line on the apron which supports the Bourdon-tube pressure gage and also acts as a housing N for the recorder. The instrument base H, which is made of Bakelite and acts as an insulating medium between the instruments, supports the two voltmeters as well as the light source G for the slot and the lamp housing F which houses lamp E 1, 2, 3, and 4 for the impulse ports. Plastic light guides C 1, 2, 3, and 4, formed from a ⅛" Lucite rod, are used to direct the light to the four ports, as there is not enough room directly under the ports for the lamps and sockets. (The first two light guides in Fig. 3 have been cut away so that the pointers of the two voltmeters and of the Bourdon gage are in evidence under the slot.) Lamp G is held in place on the Bakelite base with a clamp so that its filament is 1¼" below the center of the slot. Masking tape (not shown) is wrapped around the upright section of each light guide to eliminate stray light interference in the slot. The motor and reduction gear as well as the voltmeter and light-source assembly are secured to base I, which completes the housing.

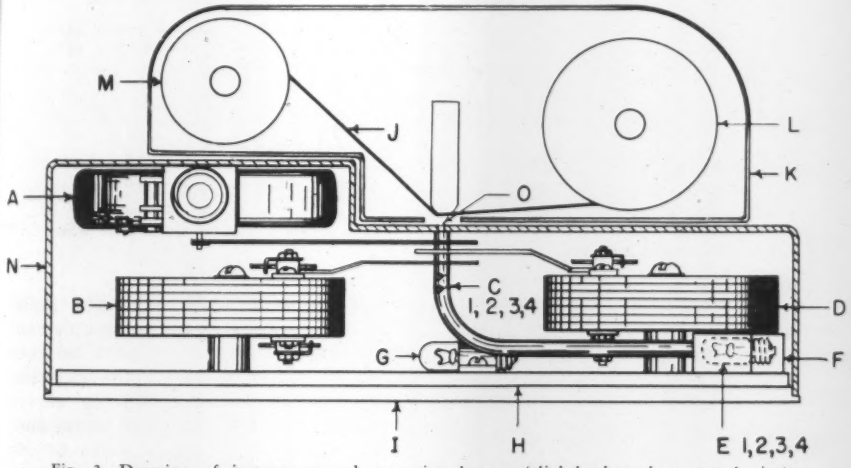


Fig. 3. Drawing of instrument and magazine layout (slightly less than actual size). A—Bourdon-tube pressure gage. B—Voltmeter. C 1, 2, 3, 4—Impulse light guides. D—Voltmeter. E 1, 2, 3, 4—Impulse exposure lamps. F—Impulse lamp housing. G—Slot exposure lamp. H—Bakelite instrument base. I—Recorder base. J—Sensitive paper. K—Magazine housing. L—Take-up spool. M—Supply spool. N—Recorder housing. O—Slot.

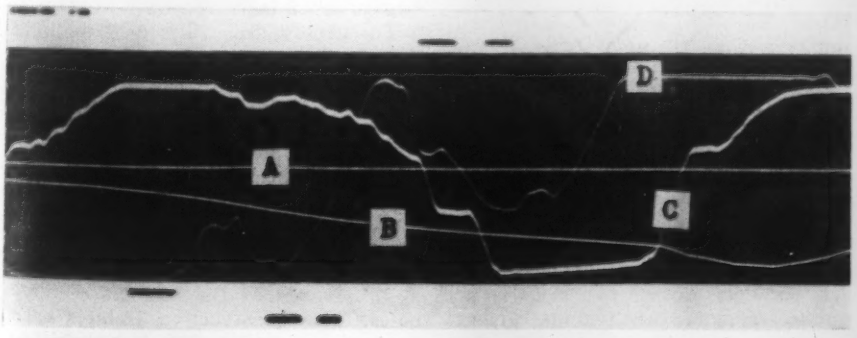


Fig. 4. Seven-element Shadowgraph record (actual size). A—Reference trace. B—Pressure trace. C and D—Voltmeter traces. Four impulse traces are on margins of record.

The lamp housing F was made in two pieces. One half was machined with four ⅛" openings (to accommodate the Lucite guide rods) on one side and four openings on the opposite to house the glass bulb section of the lamps. The other half was machined with four special threaded holes to match the lamp bases, complete with base terminals to act as sockets for the impulse lamps. This arrangement isolated the light from each source at a location where the space was available. The light was directed from this location through the four plastic rods to the proper ports. Pilot type lamps were used for the light sources.

Still referring to Fig. 3, the magazine K was made to hold 14 feet of orthochromatic extra-thin "Type XXA" sensitive paper (0.004" thick) cut 1¾" wide. With paper speed of 2½ feet per minute, a 5-minute run required 12½ feet of paper which left 1½ feet for pre-run and post-run calibrations. Supply spool M and take-up spool L were made as large as possible within the limits of the total recorder height of 3¾". The diameter of the drum on spool L was made as large as possible (and still hold 14 feet of paper) as this larger diameter gave a more constant paper speed throughout the run.

A Delco governor-controlled 6-volt motor and a Telechron "Type B" reduction gear installed in the recorder drove the take-up spool in the magazine. A gear on the magazine engaged a gear in the recorder when the magazine was in place on the recorder housing.

The motor and reduction were special products of World War II and are no longer available, so no detail is given on this part of the recorder. Any conventional motor and gear reduction of suitable size would be satisfactory in the design of a recorder of this type.

As there is no optical system of lenses, several factors must be considered for obtaining a sharp trace. The pointers must be kept as close to the sensitive paper are possible and the light source as far away as the design will permit with a minimum recommended distance of 3". This is advisable, since the filament of the exposure bulb does not give an ideal point source of light. The bulb should be installed with a plane of its filament at right angles to the sensitive paper. To eliminate reflections (which also detract

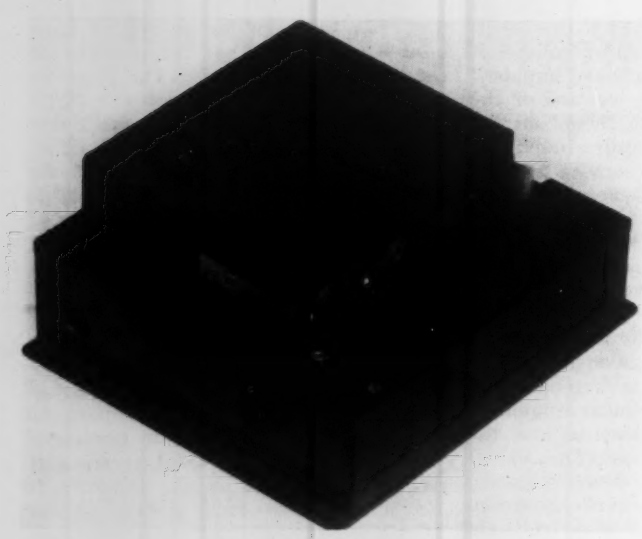


Fig. 5. The Eight-element Shadowgraph.

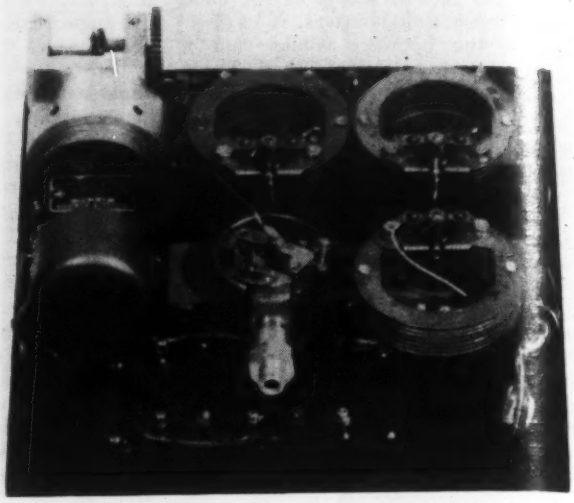


Fig. 6. Eight-element Shadowgraph with magazine and top plate removed.

from the sharpness of the trace) all surfaces common to the slot and light source should be given a coat of dull black paint. The slot width should not exceed 0.02", and the four impulse ports should not exceed 0.025" in diameter. Since it is necessary for the slot and ports to lie between the pointers and the sensitive paper, this apron should be a part of the recorder housing to eliminate any unnecessary additional space between these members. A piece of No. 28 wire is soldered across the center of the slot to form the reference line on the record.

Correct exposure is obtained at each light source by operating the lamp at the correct light intensity for a given paper speed. Speeds of approximately 1" per second or 5 fpm. will require full rated voltage on 6-volt 150-milliampere pilot bulbs while approximately 4 volts is required at speeds of 2½ fpm.

A photograph of a record run at 2½ fpm. is shown in Fig. 4.

Since the four impulse ports and the slot lie in a line at right angles to the movement of the paper, the time reference is the same for each trace. This is a great help in quickly visualizing the performance of the equipment under observation subsequent to the actual evaluation of the recorder.

This new recording method and this particular application have not been discussed with the idea of limiting the reader's conception of its possibilities. It is obvious that any of the instruments could have been replaced with a temperature indicator or any other instrument movement with a deflecting pointer. It is also possible to incorporate pointers mechanically actuated by a linkage to an external source of movement under observation. Low-torque voltage-dividing resistors which can be installed on various types of instruments or connected to mechanical movements offer an ideal means for transferring readings or positions to the voltmeters in the record.

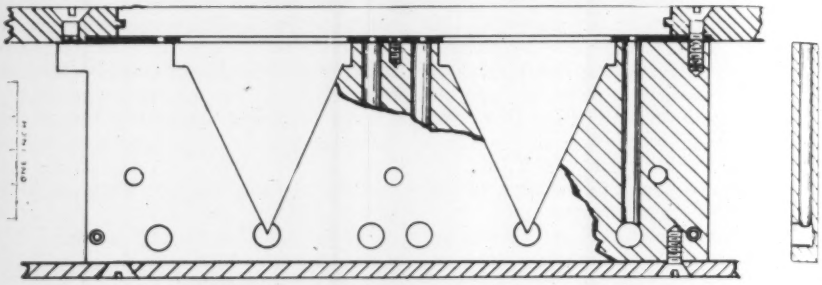


Fig. 7. Sectional view of light guide between cross sections of top plate with apron and bottom plate. (Right) Cross-sectional end view shows location of a ⅛" vertical hole and the 3/16" lamp opening for the impulse port.

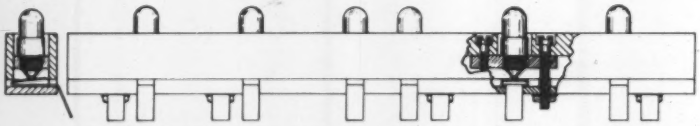


Fig. 8. Sectional view of lamp housing. (Left) Cross-sectional end view through lamp and contact-spring assembly.

The Eight-element Shadowgraph

As stated in the first part of this article, the eight-element Shadowgraph, Fig. 5, is better suited to fabrication and its design is recommended where this type of recorder can be used. This instrument is 6¼" × 6¼" × 3¾" high, and it has four impulse inputs as well as three voltmeter inputs and one pressure-gage input. Several factors contribute to the simplicity of its design, a major one being the use of a Mazda No. 325 airplane instrument lamp, rated at 0.19 amperes at 3 volts. This lamp is only 3/16" in diameter and ½" long. Its relatively small size as compared to a standard pilot lamp makes it possible to eliminate the plastic light guides used in the seven-element recorder. Additional ease in construction is made possible by using 3½" sensitive paper and exposing it through two slots with two instruments to a slot. The use of two slots makes it unnecessary to stack two instruments one above the other as in the first recorder. Construction is further simplified by using a metal light guide housing as a support for the instrument mounts as well as a support between the base and top plate of the recorder. Likewise, the motor mounting serves as a housing for the final worm-and-gear reduction and gear drive to the magazine as well as a support between the base and top plate of the recorder. The recorder with the top plate and magazine removed is shown in Fig. 6. The light guide is evident between the two rows of instruments.

The general construction of the light guide, and its location between the base and apron on the top plate, are indicated in Fig. 7. The two V cuts in the guide are directly below the slots in the apron, and the lamps lie in a 3/16" opening at the bottom of each V. Four ⅛" vertical holes in the guide, one in each end and two in the middle, lie directly below the four impulse ports in the apron, and their lamps lie in 3/16" openings at the bottoms of these holes. This construction isolates each light source and makes it possible to use the light guide for several other

purposes as stated. The lamp housing, Fig. 8, with sockets for the six lamps, is held in place at the bottom of the guide with two screws. The lamps are so arranged in the housing that their filaments are centered directly under their respective ports or slots. The housing is made of two pieces of Bakelite: one piece holds separate threaded brass plates which act as sockets for the lamps; the second acts as a retainer for the center spring contact.

A side view of the recorder with one of the side plates removed, Fig. 9, shows the arrangement of the parts as well as the multiple purposes served by the light guide F and the motor mounting G. Four side plates A slide into grooves in the top and bottom plates I and J to complete the housing proper of the recorder. These plates are clamped in place by a screw in each corner of the recorder.

The magazine, Fig. 10, has a constant-paper-speed drive which is obtained by using a driven rubber-covered drum to pull the paper from the supply spool and a slip drive on the take-up spool which otherwise has a higher speed than the rubber-covered drum. This conventional system depends on the friction between the paper and rubber-covered drum being greater than the friction of the slip clutch on the take-up spool. Tension between the paper and the drive drum is maintained by putting a slight drag on the supply spool. The magazine, which has a groove on two sides near the base, is held in place in the recorder by sliding it into a recess in the top plate on tongues machined into this part. The apron, which has the impulse ports and slots, is $\frac{1}{32}$" thick and is secured to the under side of the top plate across this recess. The drive gear of the recorder engages the gear chain in the magazine when the magazine is in place.

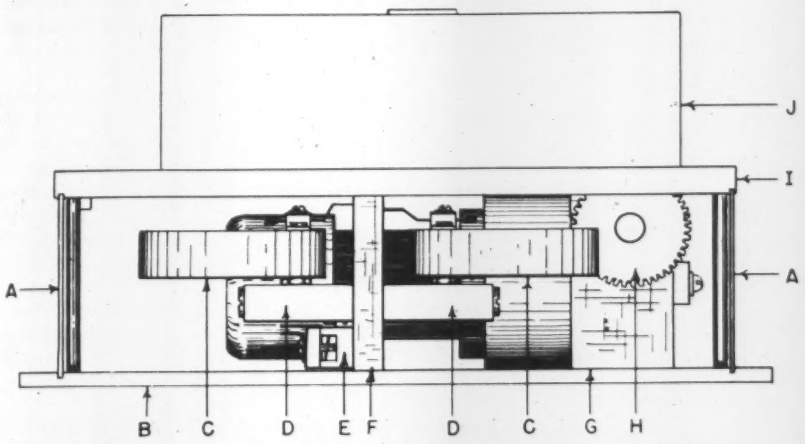


Fig. 9. Side view of recorder with one of the four side plates removed. A—Side plates. B—Base. C—Instrument movement. D—Bakelite instrument mounting block. E—Lamp housing. F—Light guide. G—Motor mounting. H—Recorder drive gear. I—Top plate. J—Magazine.

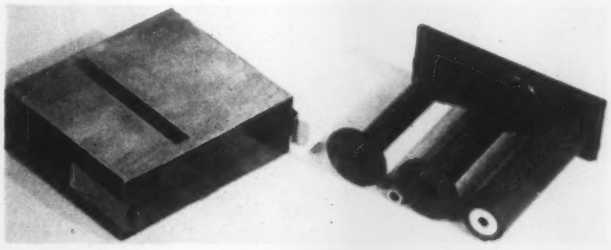


Fig. 10. Magazine with cover removed.

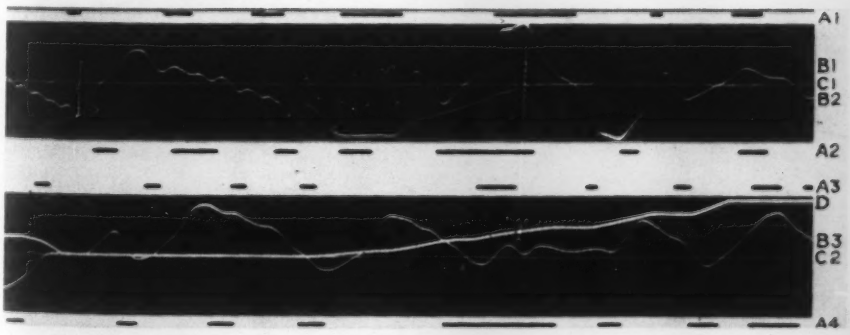


Fig. 11. Eight-element Shadowgraph record (ONE-HALF actual size). A1, A2, A3, A4—Impulses. B1, B2, B3—Voltmeter traces. C1, C2—Reference traces. D—Pressure trace.

The general construction of the magazine is evident in Fig. 10. The spool drum and gear chain are all mounted on a Dural end plate. The cover is held in place on the end plate by two spring catches. The closed end of the cover is $\frac{1}{16}$" brass, and the rest of the cover is $\frac{1}{32}$" sheet brass.

The magazine has a capacity of 25 feet of XXA orthochromatic extra-light-weight paper, $3\frac{1}{2}$" wide. Paper speeds are approximately 1", $\frac{1}{2}$" and $\frac{1}{4}$" per second. These speeds are obtained by selecting a quadruple-, double-, or single-thread worm and corresponding 30-tooth worm gear which are interchangeable on the motor mounting and drive-gear assembly.

The motor for driving the recorder is a Delco 27-volt "Type 5069230" with a built-in reduction and shaft output of 145 rpm. (These motors were used on computers and on aircraft control equipment and are available from various supply houses in quantities at $3 to $5 each.) A 48-pitch single, double-, or quadruple-thread worm is attached to the output shaft and drives a 30-tooth worm gear on a second shaft common with the drive gear to the recorder. As previously stated and in evidence in Fig. 6, the motor mounting accommodates this complete assembly. Metal parts of the recorder are made of 17ST Dural, anodized after machining, except for the magazine cover which is made of brass and given a coat of wrinkle paint. The gears are all standard 48-pitch spur or worm and gears. Ball bearings are used on the worm-and-gear reduction, and ball thrust bearings are used on the brake and slip clutch elements of the supply and take-up spools.

The resultant record is shown in Fig. 11. Identification of the traces is made possible by their width. Development of this record is a conventional procedure and only requires a few minutes. It is necessary to use a red filter on the dark room light when loading the magazine or developing orthochromatic paper.

The selection of voltmeters, pressure gages, or other recording elements for any specific requirement is limited to maximum "movement" diameters of $1\frac{3}{4}$". This dimension is common to 2" size electrical indicating instruments.

Space is available inside the recorder housing for series or shunt resistors used in connection with electrical "movements." The same is true if it is desired to use voltage-dropping resistors in series with the exposure lamps. In Fig. 6 two terminal boards can be seen as well as the resistors required on a particular application. No reference is made to their value, as their selection was made for a specific recording job.

It is hoped that this article may be a source of help in solving other recorder problems involving limited space, sensitive elements, low power requirements, and rugged characteristics.

A Portable Two-channel Recording Oscillograph for Battery Operation

By R. F. WILD, Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia.

FOR certain uses there is a need for small self-powered recording equipment, these uses being the recording of vibrations in aircraft, mechanical structures, and machinery. In an attempt to fill the aircraft need, an experimental portable two-channel recording cathode-ray oscillograph, for use as a flight vibration recorder, was developed by the Brown Instrument Company for, and in coöperation with, the Technical Development Division of the Civil Aeronautics Administration.

The recorder is designed for simultaneous photographic recording of two input signals of any frequency between five and 300 cycles per second, and from two millivolts to two volts peak amplitude, as well as for recording of marking signals to provide a time base for frequency determination. The instrument is designed for battery operation, is completely self-contained and, therefore, independent of the availability of an external power source.

String-galvanometer oscillographs are available for simultaneous recording of several signals. However, the power requirements for driving low-impedance galvanometers suitable for signal frequencies of several hundred cycles would impose serious limitations on the weight and size of a self-contained instrument of this type.

Therefore, it was decided to design a cathode-ray oscilloscope with recording camera, requiring a minimum of power for operation, which can be more practically supplied from batteries in a light-weight, compact and self-contained instrument.

Fig. 1 shows the front view of the instrument with the location of various controls and operational switches. The size of the instrument is 6" × 12½" × 16½" and its weight, including batteries, is 35 lbs.

On the left side panel there are provided two input plugs, adapted to receive cable connectors connecting the instrument to pick-up devices, strain gage circuits, or the like.

Starting from left of the front panel, there are located two attenuator switches for controlling the amplifier channel input signals and two integrator networks which can be connected into the amplifier channels, in case velocity-type pick-up devices are used with the instrument. A selection of three integrator capacitors in each network is provided for coverage of the frequency range of input signals. A sweep switch permits selection of one of three cathode-ray sweep frequencies as well as the corresponding one of three marking signal frequencies. A viewing hood is located below the sweep switch. The cathode-ray tube traces can be viewed through the hood, for checking adjustments until immediately before recording.

To the right of the sweep switch is a power switch for opening and closing eight battery circuits. Below this switch is a shutter push button for opening the film shutter and for closing the print switch for recording of traces. Finally, at the extreme right, a function switch is located. The function switch can be turned clockwise to different positions for viewing and for recording of the input signals and the marking signals.

A film-pack well is located at the extreme right center of the instrument, and a second well for a spare pack is located directly below.

An exploded illustration of the instrument, Fig. 2, is a view of the upper third of the instrument occupied by the amplifiers, marking signal generator, sweep circuits and switches; the center, occupied by the cathode-ray tube, centering and intensity adjustments, and the camera. The lower third is reserved for batteries.

The electronic circuits, shown in Fig. 3, include two preamplifier channels, an electronic switch, a multivibrator circuit for operating the switch, a marking signal generator, a sweep generator for recurrent and single sweep, and the cathode-ray tube circuits. These circuits include ten miniature tubes and one medium-size tube, all designed for battery operation, a cold-cathode gas discharge tube, and a cathode-ray tube.

Each preamplifier channel includes an input attenuator, having a total resistance of about one megohm, divided in eight steps, each about 30% of the preceding, from one to 0.0001. Each channel includes two amplifier stages, using 1L4 tubes, and compensated for low-frequency amplification to provide a relatively small drop in gain from 300 to 5 cps.

Between the first and second stages, an integrator network, comprising a resistance-capacitance circuit, can be inserted at will. Three integrating capacitors of different values are selectively connected into the integrator network, depending upon input signal frequencies.

The electronic switch, for mixing the amplifier output signals at a switching rate of about 20 kc., includes two 1R5 tubes. These tubes, operating with different bias voltages on the second control grids, effect permanent separation of the two input signal traces on the cathode-ray tube screen.

The switch tube circuits are compensated for low- as well as high-frequency amplification, since they must now pass a band from 5 cps. to a frequency approaching one-half megacycle.

The electronic switch is excited by a multivibrator circuit, including two 1S4 tubes, operating with positive grid bias, and producing out-of-phase square waves of about 20 kc. These output

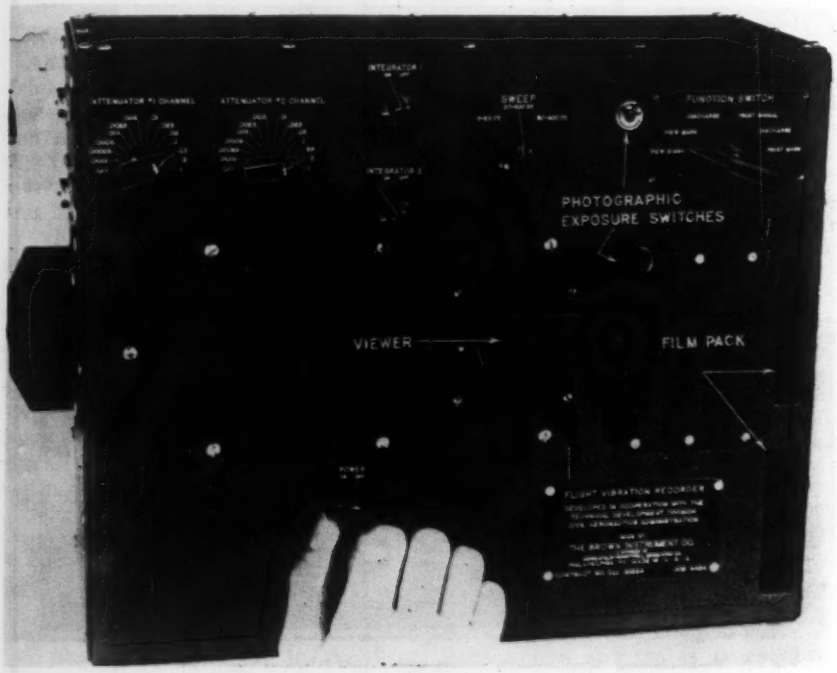


Fig. 1

waves are applied to the first control grids of the switch tubes. The relatively high switching frequency was chosen to minimize gaps in the signal traces, due to switching of the cathode-ray between traces. Care is taken to generate square waves with a minimum of distortion and also for preserving the wave shape and minimizing the halo between signal traces.

As a rule multivibrators produce waves which have a horizontal portion and a sloped portion during alternate half-cycles and are not truly square waves. In the present instrument, care has been taken to apply the multivibrator output waves with such phase and magnitude to the switch tubes that the latter are fully cut off during occurrence of the sloped wave portions. In this manner, distortion of the multivibrator output waves is made harmless.

A final wide-band amplifier stage, using a 1L4 tube, is coupled to the electronic switch. This amplifier stage is compensated for low- and high-frequency amplification and is connected to the vertical deflecting plates of the cathode-ray tube for certain positions of the function switch.

The marking signal generator is a resistance-capacitance relaxation oscillator, including a twin triode tube, Type 1G6.

One of three different resistors can be selectively connected into the common cathode circuit by means of the sweep switch, to enable generation of marking signals at 24, 40 and 100 cps. respectively. This circuit is a modification of a known relaxation oscillator and produces a different wave form at each of the three operating frequencies for the purpose of convenient identification of marking frequency.

Each of the wave-forms has steep wave fronts, providing a sufficiently accurate time base. The output circuit of the marking signal generator is connected to the vertical deflecting plates of the cathode-ray tube in certain positions of the function switch.

The marking signal generator is permitted to operate only during viewing and recording of marking signals. At all other times, it is made inoperative by shorting the control grid of one of the tubes to ground. This obviates the need for elaborate shielding to prevent the marking signal from feeding into the amplifiers; space limitations would make proper shielding difficult.

The sweep circuit is capable of producing recurrent sweep waves for viewing the signal traces and single-sweep waves for recording these traces.

A single sweep for recording was chosen because the two input signals to be recorded need not have equal or even commensurate frequencies. Therefore, it would not always be possible to find a recurrent sweep frequency commensurate with the input signal frequencies. The recurrent sweep is intended for viewing only, to check the presence of signal traces and adjustment of their amplitudes. It is not provided with any fine frequency adjustment.

To obtain an input signal record which can be conveniently analyzed, three sweep frequencies are provided, so that a record of not less than two complete cycles and not more than 10 complete cycles of any frequency in the band between five and 300 cps. can be obtained. These sweep frequencies are 2.5 cps. for input signal frequencies from five to 25 cps., 10 cps. for input signal frequencies from 20 to 100 cps., and 40 cps. for input signal frequencies from 80 to 300 cps.

The sweep switch is used to select recurrent and single-sweep frequencies as well as the marking signal frequency in a single switching operation.

The sweep circuit comprises a large capacitor charged through a 1S4 pentode tube, thus obtaining a linear sweep voltage across the capacitor. The sweep frequency is adjusted by varying the control grid bias voltage of this tube, thus varying the capacitor charging current. For recurrent sweep the capacitor is discharged through a cold cathode gas-filled tube, Type 1C21.

For single sweep the gas tube is disconnected from the circuit by means of the function switch, the capacitor disconnected and discharged by short-circuiting. The single sweep is initiated by connecting the capacitor again into the charging circuit by means of the print switch which is mechanically actuated by the film shutter push button. The sweep voltage is applied by direct coupling of the capacitor to one of the horizontal deflection plates of the cathode-ray tube, to avoid deflection distortion by coupling networks.

A two-inch cathode-ray tube, Type 2AP5, is used, yielding a blue trace favorable to photography; its associated circuits include three controls for centering the input signal traces and marking signal traces vertically and horizontally, as well as controls for focusing and intensity.

Because the sweep speed varies by a ratio of 16:1 for fast and slow sweep, a control coupled to the sweep switch is provided for applying different bias voltages to the control grid of the cath-

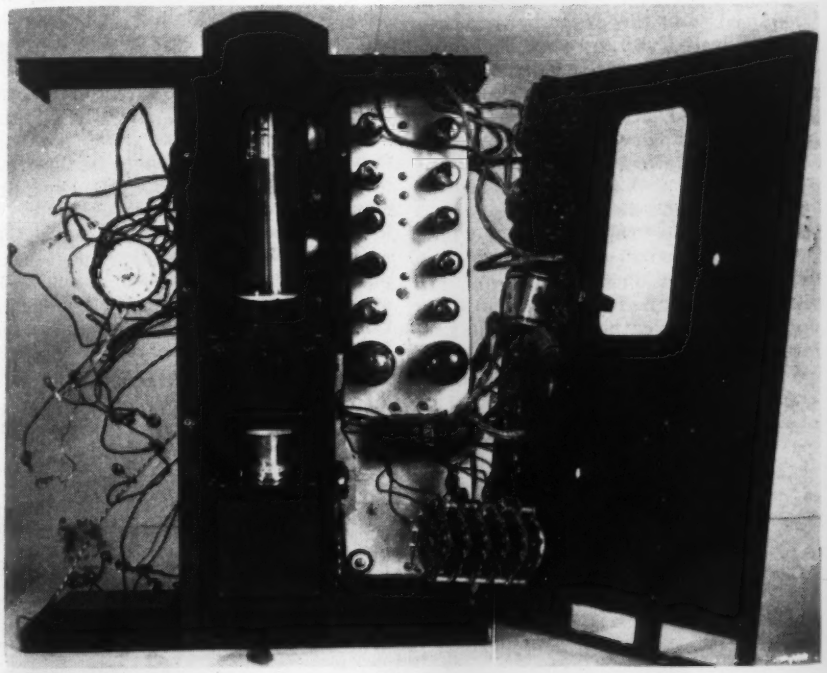


Fig. 2

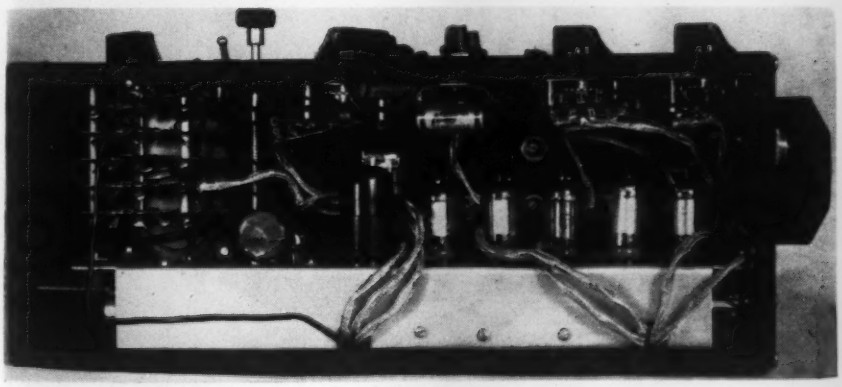


Fig. 3

ode-ray tube for each of the three sweep frequencies. In this manner the cathode-ray intensity becomes more evenly matched to its deflection velocity, resulting in a more nearly constant intensity of the photographic record.

The cathode-ray velocity is greater for input signal traces than for marking signals because of their greater amplitude and because of the interruption of the input signal traces by the action of the electronic switch. Since this action would result in producing a considerably more intense trace of marking signals than of input signals, contacts are provided on the function switch for applying different bias voltages to the control grid of the cathode-ray tube for marking and input signals. The traces of both signals are of substantially equal intensity.

The function switch, above referred to, is used to make proper circuit connections in the instrument required for its various functions, namely:

1. Viewing of the vibration signals with periodic sweep.
2. Viewing of the marking signals with periodic sweep.
3. Discharging of the sweep capacitor before printing on single sweep.
4. Printing of the vibration signals on single sweep.
5. Discharging of the sweep capacitor before printing on single sweep.
6. Printing of the marking signals on single sweep.

The camera arrangement for viewing and recording the signal traces is shown in part in Fig. 2. This arrangement comprises a reflector positioned between the cathode-ray tube screen and the camera lens for reflecting the cathode-ray traces through the viewing hood for direct viewing.

When the viewing hood is closed for recording, the reflector is automatically depressed and moved out of the optical path between the screen and the lens. The camera housing is provided with an internal shutter which normally provides a light-tight seal to prevent extraneous light from reaching the film pack during viewing of the traces. The shutter, obviating the need for reinserting the slide into the film pack after each exposure, is actuated by means of the shutter push button mounted on the front panel. The shutter is depressed when records are made.

The camera is equipped with an F2 lens having a focal length of 50 mm. and records are made on film pack, size 2¼" × 3¼" with 12 exposures. In commercial film packs each exposure bears a number, permitting easy identification of records.

The power and bias voltage supply for operation of the instrument consists of 22 batteries and four groups of button type bias cells, all housed inside the case, occupying about 330 cubic inches and weighing approximately 20 lbs. This source supplies 1.35 amperes to tube filaments, the heaviest load being the cathode-ray tube filament with a current drain of 0.6 amperes. A total current of approximately 70 ma. is supplied to the tube circuits by eight 67.5-volt batteries. The shortest life of any battery is approximately eight hours of continuous operation. A terminal board is provided in the rear of the instrument for convenient checking of battery voltages.

Operation and Performance

The preparatory adjustments to be made before recording are few and simple. The viewing hood is opened to allow observation of the input signal traces

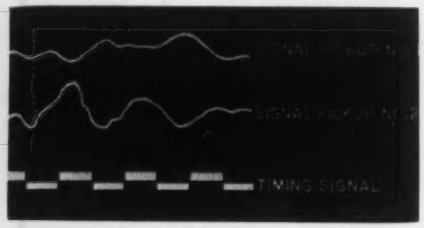


Fig. 4

on the cathode-ray tube screen, while the function switch is in "View Signal" position. The attenuators are then adjusted for proper input signal level, the integrators connected into the circuits if required, and the proper sweep frequency selected. By turning the function switch into the "View Mark" position, a visual check of the marking signal is provided. After all adjustments are made, the viewing hood is closed, removing the reflector from the optical path.

The function switch is advanced through position "Discharge," in which the sweep circuit condenser is discharged, to position "Print Signal," in which the amplified input signals are applied to the cathode-ray deflection plates.

When the push button on the front panel is depressed, the light path is freed between the cathode-ray tube screen and the film by moving the shutter out of the optical path. When this button is depressed, the print switch is also actuated, causing the sweep circuit capacitor to become charged and the cathode ray to traverse the screen once, thereby leaving a permanent record of the input signal traces on the film.

After turning the function switch through the second "Discharge" position to the "Print Mark" position, the same operation is performed for recording the marking signal.

Fig. 4 shows the type of record obtained, in which the upper two traces represent the input signals, while the lower trace represents the marking signal, provided as a time base.

Conclusion

The instrument described was designed primarily for the study of vibration and dynamic strain in mechanical structures and machinery. It has a high input impedance and is intended for use with vibration pick-up devices and strain gages. Owing to its light weight, compactness, ease of installation, and simplicity of operation, it may be of interest to those concerned with such studies.

Tests made by the Technical Development Division of the Civil Aeronautics Administration have shown the instrument to be valuable in the study of flutter in aircraft, supplementing equipment weighing between 300 to 500 lbs. and requiring an installation time up to two weeks. This instrument makes possible vibration studies in small aircraft, where space and weight limitations make the use of bulky equipment impossible.

The instrument is likewise useful for simultaneous recording of any two input signals, regardless of their origin.

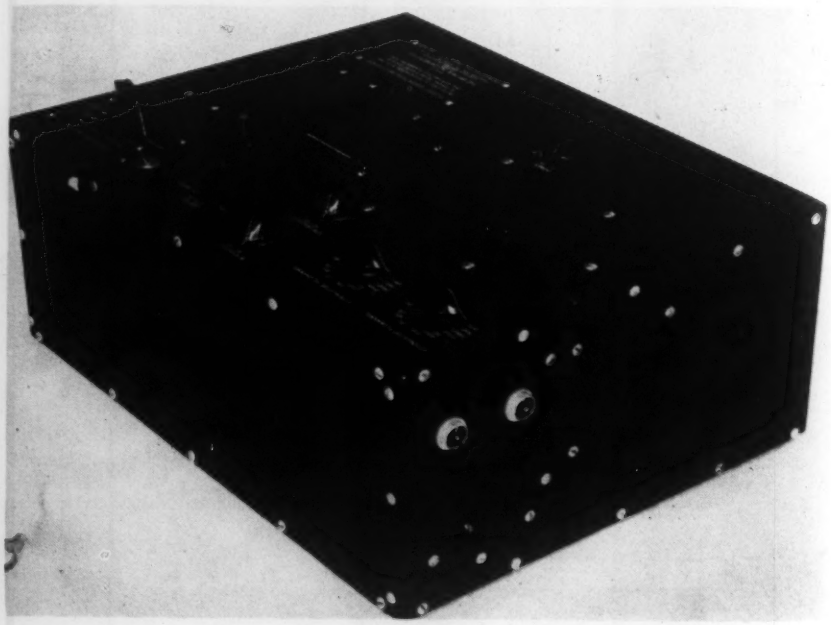


Fig. 5

A New Method for the Measurement and Control of Consistency of Thin Stock in Pulp and Paper Mills

By WILBUR F. PRAY, Askania Regulator Co., Chicago, Ill.

WATER is the great common carrier in the manufacture of pulp and paper. And one of the ever-present problems in the industry is, and always has been, how to maintain just the right mixture of pulp and water to suit the requirements at each particular point in the process.

This mixture, or proportion, commonly called consistency, varies from ¼ lb. of pulp and 99¾ lbs. of water to 12% pulp and 88% water—and even higher if it can be handled.

The manufacture of pulp and paper is really a series of continuous steps wherein the pulp is diluted and thickened, and also pumped, screened, washed, bleached, beaten, refined, etc. And for each of these steps there is an optimum consistency which, if properly determined and maintained, will result in any one, or all, of many greatly-to-be-hoped-for results: less power per ton, more production, less rejection of good pulp, higher efficiency, less labor, cleaner pulp, higher quality . . . and other results more dreamed about than realized.

Although the paper industry is quite old, it is only about thirty years ago that attempts at measuring and controlling stock consistency began to meet with any success.

It had long been known that as the consistency of stock increased, more power and larger pipe lines were required to transport the stock. This very simple characteristic produced also a sort of self-compensating consistency regulation. That is to say, as the stock thickened, less of it flowed, and vice versa. Possibly this kind dispensation of providence delayed the birth of any real attempts at true consistency regulation until a man in Glens Falls, New York, whose name has since become famous in the industry, used this principle—which everyone knew but never did anything about—to build the first real consistency regulator. In effect he put to work this fact that in the behavior of any mixture of pulp and water there is a relation between viscosity and consistency and if other factors (which may be minor but do enter into the picture somewhat) are neglected, the two may be used interchangeably. So, the problem reduced itself to finding some way to measure changing viscosity or, if you will, loss of head in a pipe line due to friction.

The various ways in which this principle has been applied since that time are numerous and highly ingenious. It is not the purpose of this article to detail them although a few might be mentioned: loss of head through a friction tube or in an open channel, changes in density, changes in torque required to drive a propeller or paddle in the stock and similar methods.

It has been well said that the perfect consistency regulator has yet to be invented.[1] Nor is it the purpose of this article to make any claims to the invention or discovery of the perfect consistency regulator.[2] What this article is about is the fact that all of the existing viscosity-consistency detectors and regulators with which the author is familiar leave practically untouched a wide field in the pulp and paper industry—*the consistency range of about one and one-half percent and below.* To further explore this statement, it is interesting to look at a plot of the information found in Cameron's Hydraulic Data on the behavior of pulp stock in pipe lines (Fig. 1). Here we see that the consistency-viscosity relationship is very marked from at least 2% up. Below this point it is plain that any method of consistency detection and control which depends on this relationship is, to say the least, likely to get into trouble. If this is accepted—and each reader must make up his own mind on this point—it is obvious that there is a field of consistency regulation which has been practically untouched. Additional evidence to this end lies in the fact that consistency regulation in these low ranges is practically unknown in the pulp and paper industry today.

Is it then not clear that if regulation is to be effected in this low range, another approach than that of the consistency-viscosity relation must be found? As a matter of fact another approach has been made—and by at least three different people, all of whom were working in the same direction apparently entirely unknown to one another. This approach took advantage of another well-known fact: that consistency had an effect on the *drainage rate* of the stock when it was laid on a wire or perforated cylinder. To illustrate the principle, a diagram of such a consistency measuring set-up is shown (Fig. 2). A mechanism similar to a pulp decker is constructed and stock is supplied to it at a constant flow-rate. The resistance to flow caused by the stock formation on the upstream face of the cylinder will cause a variation in head of the water upstream from the cylinder which will be proportional to some characteristic of the

(1) Frederick Wierk, *Paper Trade Journal*, July 11, 1940.

(2) As a matter of general interest there seems to be a universal demand, or shall we say hope, on the part of pulp and paper men for a consistency detector which will go in the line like a flowmeter and control the addition of dilution water at the suction end of the pump. Any bright boys having ideas on this subject will have an interested and sympathetic listener in the author of this article.

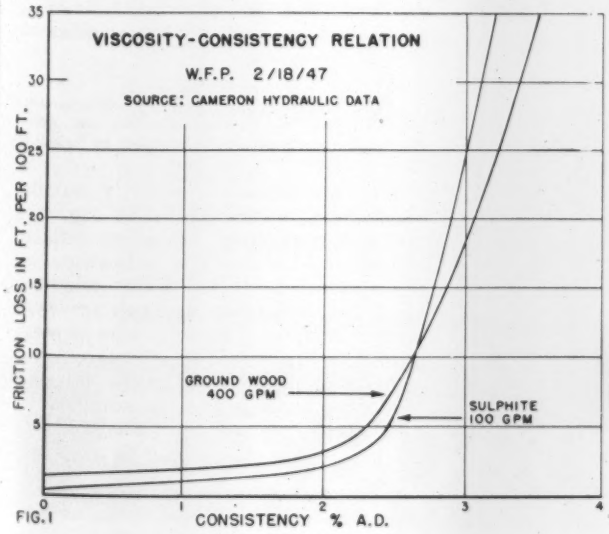


FIG. 1

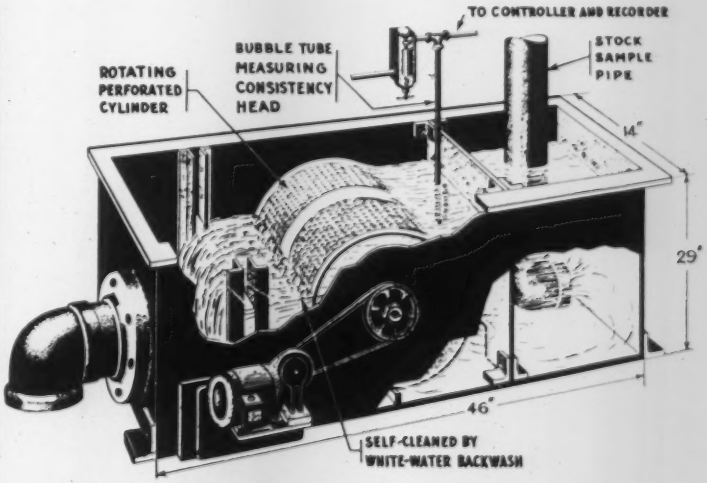


Fig. 2. A practical embodiment of the new method, designed to measure stock consistencies in the range from 0.1% to 1.25%.

stock. This characteristic, for want of a better term, is called drainage rate and is a combination of at least two definite properties, namely, consistency and freeness, plus some minor variables as yet undetermined. If constant freeness is assumed (and it may be assumed with the same stock) Fig. 3 shows the relation between the upstream head in the detector box and consistency variations as determined under laboratory conditions. It will be seen that this relationship is linear and can be used as the primary measuring indication in automatic consistency regulation. Fig. 4 shows the result of experimental data taken in a sulphite mill screen room that shows that, at least within the limits of routine mill laboratory tests, the relationship is still sound.

Fig. 5 shows a 24-hour record of consistency variations as recorded by a detector box in operation on the stock as it is pumped from the blow pits to the screen room in a sulphite mill.

The proposition is advanced, therefore, that for any process in the pulp mill where freeness is relatively constant, i.e., unrefined pulp in any knotting, screening, washing, filtering or wet machine operation and the like, a method is available for detecting, measuring and controlling, with reasonably high reliability and accuracy, consistency variations in the low ranges not susceptible of adequate handling by previously-accepted viscosity-consistency methods. The question then will be asked, "What of the multitude of applications in the paper mill or the ground wood mill where the stock is subject to wider freeness variations?"

It is a good question and can only be answered conditionally at th time. The manufacture of pulp and p er is still an art and not an exact sci ce. It is still a problem of handling a ulti-tude of sometimes unrelated and sual-ly difficult-to-measure variable For instance, consider the stock sup y to the vat of a cylinder machin The ideal which the paper maker is l king for is a supply of stock at a co stant weight-rate of dry fibre which w ll al-ways act on the cylinder in the same way or, roughly, have a constant rain-age and formation characteristic.

Now the control means under dis-cussion is made up of a conglomeration of these two factors (consistency and freeness) which, when added together, mean weight-rate plus drainage-rate.

The author can possibly be accused of wishful thinking but it is conceivable that if, on any given Fourdrinier or cylinder machine this characteristic (call it "X" if you wish—made up of consistency plus freeness plus unknowns) is held constant by some automatic means, it might reduce the number of variables which plague the operator, and wind up in an improvement of the process. After all, the way to judge these things is not how near absolute perfection are the results but how much improvement, if any, can be had over what now prevails.

So far, this article has described a new method of *measuring* this elusive quality of paper stock and little has been said about what to do with the indication from the measuring element once it has been secured. At this point, however, it is proper to state that this indication is a *good* one for automatic-control purposes—and to explain what is meant by a "good" indication or signal. Instead of advancing our own definitions and criteria, we shall quote the only author who has analyzed and classified indications and their numerous properties. In his most recent discussion[3] of the importance of the *quality* of the indication, M. F. Behar declared that "the proper performance of a controller depends, as does that of a manager, on the correctness and timeliness of the information which it receives" and he classified indications according to various basic schemes. One of these was:

(1) *Static* or no-moving part;
(2) *Kinetic* or mechanical-displacement. (Kinetic may be further divided into *kinematic* or "no-force" and *dynamic* or "accompanied by force.")

The indication obtained from the measuring element shown in Fig. 2 is not a microvoltage or other delicate signal; it is a dynamic indication—an air pressure up to 10" water column—ideal for actuating a diaphragm-type control relay such as a jet-pipe or other sturdy device suited to mill service.

As to "*correctness*," there is practically no error in the measurement of hydrostatic pressure by a bubble-pipe

(Continued on page 568)

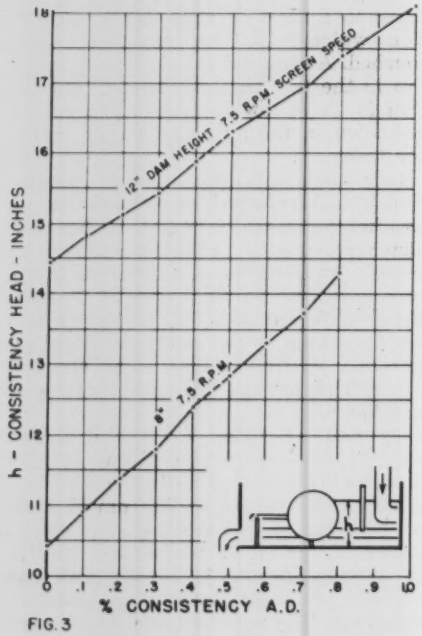


FIG. 3

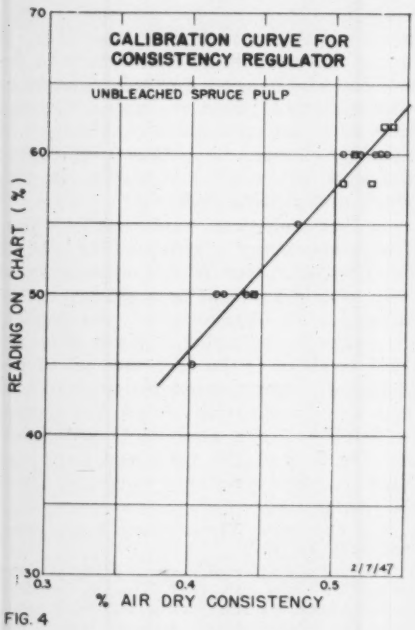


FIG. 4

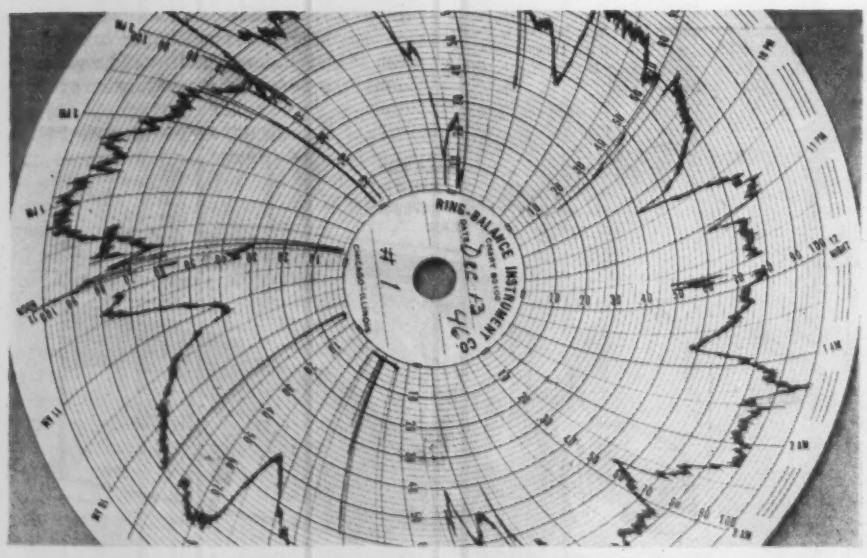
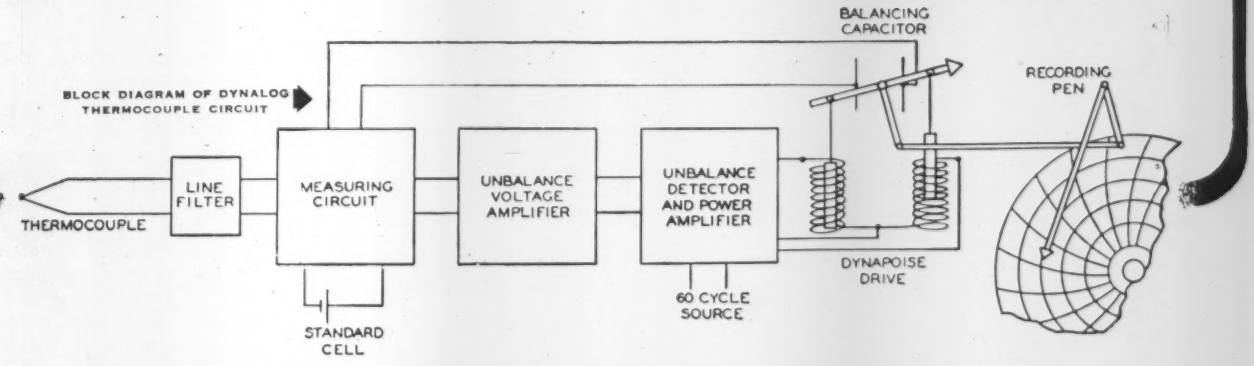


Fig. 5. Record of *uncontrolled* screening operation. Point 50 on chart (linear mid-point) represents 0.3% consistency. Total chart range equals 5" change in consistency head. Each ¾" change in consistency head equals 0.1% change in consistency with this particular stock, which is unbleached unscreened spruce sulphite.

(3) M. F. Behar, *Instruments*, Aug. 1948, page 446.

NEW DYNALOG CONTROLLER for THERMOCOUPLES



Practically Eliminates Maintenance!

EMPLOYING THE FIRST wholly-electronic design ever developed for industrial thermocouple instruments, Foxboro's DYNALOG Controller offers a combination of speed, accuracy and sensitivity never before available in controllers.

What's more, the simplicity of DYNALOG design practically eliminates maintenance. Here's why:

NO SLIDEWIRE—Complete slidewire mechanism is replaced by simple balancing capacitor.

NO MOVING CONTACTS—Slidewire contact is eliminated by positive-connected capacitor.

NO GEARS—Only simple direct linkage.

NO ROTARY MOTORS—Balancing drive motor is simple push-pull magnetic type. No brushes, commutator or bearings.

NO GALVANOMETER—Not affected by vibration.

NO BATTERIES—No standardizing. Measured voltage is compared directly to standard cell.

NO SERVICING—except simple replacements of standard widely-used type vacuum tubes.

Write for Bulletin 397 containing full details of DYNALOG Controllers in air-operated (Model 40) and electric (Rotax) types. **The Foxboro Co., 46 Neponset Avenue, Foxboro, Mass., U. S. A.**

FOXBORO REG. U. S. PAT. OFF. **ELECTRONIC INSTRUMENTS**

Scientific Glass Blowing and Laboratory Techniques

By WILLIAM E. BARR and VICTOR J. ANHORN, Gulf Research & Development Company

XII. GAS ADSORPTION APPARTUS FOR MEASURING SURFACE AREAS *(continued)*

Description of the Apparatus *(continued)*

Bath, Furnace and Thermometer

Besides the above-mentioned parts of the system there are three pieces of equipment that are essential; the liquid nitrogen bath which is used to keep the adsorbent at the proper temperature, a sensitive thermometer to measure the temperature of the bath and a furnace suitable for heating the adsorption bulb and sample while it is being evacuated.

Since the bath is to hold liquid nitrogen at −197°C. it is necessary that it be of the Dewar type. It has been found that a 665-cc. wide-mouth "Thermos" jar is the most convenient bath. Liquid nitrogen has a tendency to stratify thermally but a slow stream of nitrogen gas bubbled through the bath will agitate it and keep the temperature uniform. Since the temperature of liquid nitrogen is below the temperature at which oxygen condenses, the oxygen in the air condenses into the liquid causing the temperature to increase slowly. The nitrogen agitator decreases this effect since it keeps a layer of nitrogen gas over the liquid. A loose-fitting cover with holes to admit the adsorption bulb and thermometer is effective in keeping the temperature constant. The tendency of liquid nitrogen to condense oxygen is a potential source of danger. Upon standing the liquid becomes oxygen-rich. In cases where the bath has been used all day and then allowed to stand overnight, the residue which remains the next morning may be almost pure oxygen. Liquid oxygen must of course be kept out of contact with organic materials.

Since P_0, the vapor pressure of nitrogen at the temperature of the adsorption (approx. −195°C.) is needed, it is most conveniently obtained from vapor pressure-temperature tables such as those given by Farkas and Melville[3]. Thus it is necessary to know the temperature of the bath accurately. Since the vapor pressure of nitrogen varies from 922 mm. at −194°C. to 833 mm. at −195°C., in order to know P_0 to the nearest millimeter, the temperature must be known to at least 0.01°C. This can be done with a good thermopile (at least ten junctions) and a potentiometer capable of measuring differences of a microvolt. A less expensive apparatus is an oxygen vapor pressure thermometer. The construction and technique of filling an O_2 thermometer is very well described in Farkas and Melville[3]. A good source of pure oxygen is to fill a 250-cc. bulb one-quarter full of C.P. potassium permanganate and seal it to a 1" tube 10" long filled with glass wool to catch dust and then through a stopcock to the thermometer. This should of course be evacuated with the rest of the system. A brush flame will easily decompose the $KMnO_4$ giving off very pure oxygen. $KMnO_4$ decomposes at 240°C. The thermometer must be mounted in such a way that it can be removed from its position beside the adsorption bulb whenever the adsorption bulb is being degassed in the furnace. A hinged rack or movable stand will accomplish this very conveniently.

The final piece of equipment is a furnace for degassing the sample. Since most porous materials adsorb gases which may be held more or less firmly to the surface, simple evacuation is seldom sufficient to remove all the adsorbed gases. To completely free the surface of all adsorbed molecules may require evacuation for many hours at temperatures of 1400°C. or higher. Fortunately it is seldom necessary to go to such extremes when the surface area is to be determined. Unless a solid has been exposed to organic vapors, adsorbed water vapor is the only substance likely to cause trouble. Heating under vacuum to 150° or 200°C. for an hour is generally sufficient to degas most samples. In cases where the solid has been exposed to organic substances such as chloroform, benzene or acetone, it may be necessary to raise the temperature to 400 or 500°C. The most simple type of furnace to make and use is a glass or ceramic tube of sufficient diameter to fit over the adsorption bulb. This ceramic tube is wound with resistance wire and covered with some insulating material. A "Variac" or other voltage control can be used to adjust the temperature of the furnace.

Surface Area Determination

After the apparatus is assembled it should be completely tested for its capacity to hold a vacuum. It is generally found that a newly-erected system cannot be evacuated to a good vacuum because of adsorbed water vapor on the glass walls of the system. This may be easily removed by heating the glass tubing (being careful not to heat the stopcocks) with a brush flame while the vacuum pumps are in operation.

The next step is to calibrate the free volume of the adsorption system. This is the portion of the system, Fig. 157, between stopcock *A*, the zero reference of the burette and the zero reference of the manometer. The volumes of the various bulbs are already known by the mercury calibration. To determine the volume of the free space (V_0), with the stopcock *A* closed and mercury in the manometer, enough gas (either nitrogen or helium) is admitted to the adsorption system to give a pressure of 700 to 800 mm. when the mercury in the burette is at the zero reference. The stopcock to the gas manifold is then closed and the pressure determined with the mercury in the burette on the zero reference. The mercury is then lowered to the No. 1 reference point and the pressure redetermined, this is repeated at the next reference point and so on until all the burette bulbs have been emptied of mercury. We now have a series of pressure readings and we know the total volume of the burettes which were not filled with mercury, V_{tB}, for each pressure reading. Assuming the temperature remained constant during the calibration run and bearing in mind that a constant amount of gas was used throughout we have

$$\begin{aligned} &PV = \text{constant} = K \\ &\text{but } V = V_0 + V_{tB} \\ &\text{hence } PV_0 + PV_{tB} = K \\ &\text{or } PV_{tB} = K - PV_0 \\ &\frac{d\,(PV_{tB})}{dP} = -V_0 \end{aligned} \qquad (33)$$

Hence if we plot PV_{tB} vs. P for each point taken, it should give a straight line the slope of which is the negative of the free volume. Since V_{tB} was corrected to 0°C., V_0 will already be referred to the same temperature. Fig 159 shows such a plot.

We now know the volume of all the parts of the system up to the stopcock *A*. Rather than having to add up all the volumes each time they are used it is convenient to make a table of the volume of the system for each position of the mercury in the burette. Since the gas in the system will always be corrected to s.t.p. it saves time if these volumes are multiplied by 273.2/760. The resulting set of factors will be called volume factors (f_v). Thus for any amount of gas in the system for which the pressure and temperature have been determined

Close the Gap- BETWEEN ... AND OPTIMUM PERFORMANCE WITH...

Solenoid High Vacuum Valve
110 Volts D. C.

INDUSTRIAL high vacuum processes . . . the manufacture of refrigeration units, electronic tube production using trolley exhaust systems and rotary machines . . . demand maximum efficiency. Elimination of manual control with its waste of time and labor can be a large part of the solution.

The new DPI Solenoid High Vacuum Valves provide instant finger-tip control over high vacuum systems. They constitute a positive advance toward fully automatic control of high vacuum production. What savings they can deliver in time and effort, and how far they can "close the gap," can be determined only after individual study.

DP INC

For further information on Solenoid High Vacuum Valves write —

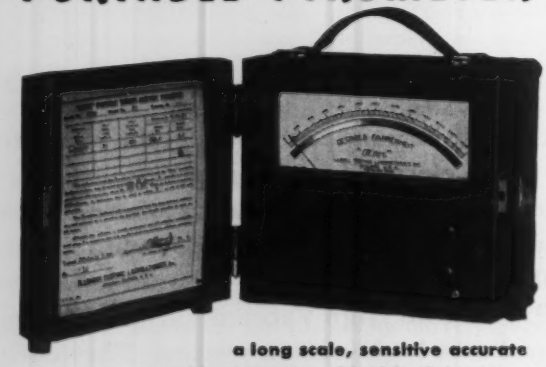
Vacuum Equipment Division
DISTILLATION PRODUCTS, INC.
Rochester 13, N. Y.

Cyclohm | **SYNCHRONOUS CAPACITOR TYPE MOTOR**

This new Cyclohm 29 Size has no equal as a synchronous, capacitor type motor for recording, tape pulling, facsimile work and other jobs which require a *quiet, smooth, vibrationless* motor. Internal rotor slots permit a higher starting torque and a quieter performance. Substantial cap seats, turned in the frame and end caps, ensure perfect rigidity, accurate bearing alignment, uniform air gap, and a vibration-free motor. Supplied with either ball bearings or sleeve bearings — in ratings of 1/100, 1/75 and 1/50 horsepower, 1800 r.p.m., 115 volts, 60 cycles. Write for complete information.

CYCLOHM MOTOR CORP.
5-17 46th Road, Long Island City 1, N.Y.

Alnor *type 1760*
PORTABLE PYROMETER



a long scale, sensitive accurate portable pyrometer, ideal for laboratory and similar service.

Type 1760 Portable Pyrometer with the special thermocouples provided, affords extremely accurate temperature readings. Long mirror scale and knife edge pointer make accurate readings easy. High internal resistance allows moderate variation in thermocouple size, and length of connecting wire, without affecting accuracy. Internal automatic cold end compensator is standard equipment.

Type 1760 is available with single range and two range scale. Standard ranges from 0-300 deg. F. to 0-2500 deg. F. With rare metal thermocouple, range 0-3000 deg. F. Write for Bulletin 2416 with complete listings of all types.

ILLINOIS TESTING LABORATORIES, INC.
142 WEST HUBBARD STREET
CHICAGO 10, ILLINOIS

$$V \text{ at s.t.p.} = \frac{f_v \times P}{T} \qquad (34)$$

where f_v is taken corresponding to the number of burette bulbs used, T is in degrees absolute.

Once the system is calibrated it is ready for actual adsorption measurements. The adsorption bulb is filled with a weighed amount of the solid under investigation and the stopcocks are set so that the entire system including the adsorption bulb will be evacuated. The furnace is put in place surrounding the adsorption bulb and adjusted to the proper temperature. After the degassing has proceeded for at least an hour and the McLeod gage shows the minimum pressure, the furnace is removed and stopcock A closed.

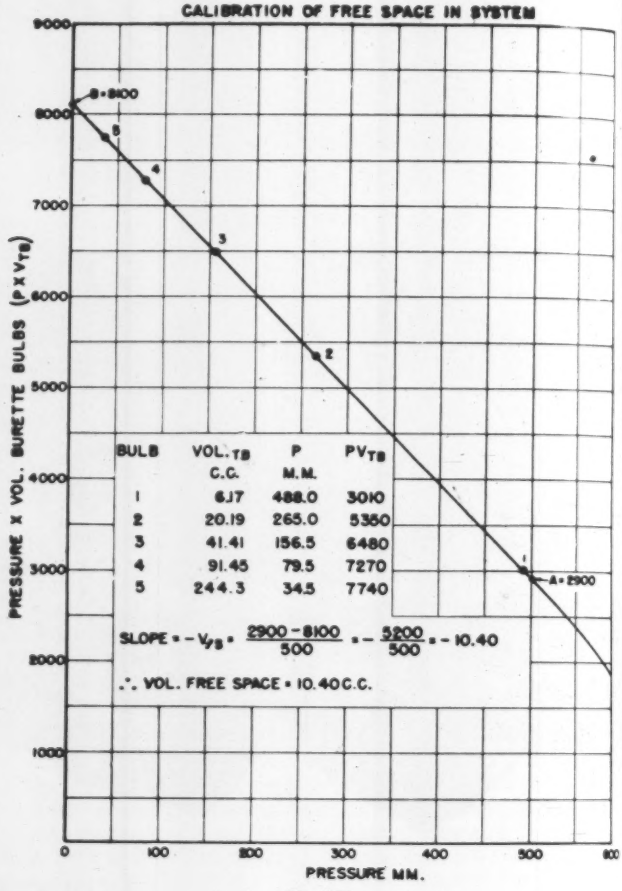


Fig. 159

After cooling, the liquid nitrogen bath is placed in position so that the adsorption bulb is completely immersed in the liquid.

The free volume of the adsorption bulb must of course be determined, i.e., all the space in the adsorption bulb not occupied by the solid. This volume includes the space contained in the pores of the sample. This can only be done by using a gas which is not adsorbed at the low temperatures of the bath. Helium serves the purpose very well.

To obtain this free space a rather large sample of helium is introduced into the burette system with stopcock A still closed. The pressure is measured and the volume of helium is corrected to standard conditions as previously described. This volume is designated as V_T (He). The stopcock A is then opened and the helium admitted to the adsorption bulb. The new pressure P_1 is then determined. From P_1, the temperature of the burette and the corresponding bulb factor the volume of helium remaining in the burette system V_R (He) can be determined. The volume of gas which entered the adsorption bulb when the stopcock was opened is then

$$V_T \text{ (He)} - V_R \text{ (He)} = V_A \text{ (He)} \qquad (35)$$

How to add "SELL" to your

DIALS, PANELS & PLATES

Premier Dials, Panels and Nameplates combine maximum utility with the added PLUS of sales appeal. Sharp, clear and accurate! Rich colors and "baked-in" finishes! Premier metal products reflect this superiority in increased sales for you.

Etched and Lithographed on

- Aluminum
- Bronze
- Monel
- Brass
- Copper
- Nickel Silver
- Stainless Steel

WRITE FOR BOOKLET

PREMIER METAL ETCHING CO.

Quality Products for Over 35 Years

43-21 21st STREET, LONG ISLAND CITY 1, N. Y.

YES—IT'S TRUE!

Gothard INDICATOR LIGHTS ARE NOW A JOHNSON PRODUCT

NO CHANGE—IN PRODUCT. The same exclusive features such as. rigid non-short terminals, bakelite washers and others, standard in all Gothard Lights, will continue to insure above average service life and satisfaction. Just com pare their superior workmanship.

NO CHANGE—IN POLICY. Standard basic prices and standard discounts will be adhered to in all cases.

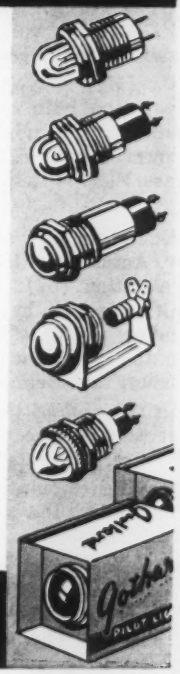
NO CHANGE—IN CATALOG ITEMS. The current Gothard catalog is still in force.

REMEMBER—send your specifications for recommendations and your orders for Gothard Quality Lights to—

Gothard Division

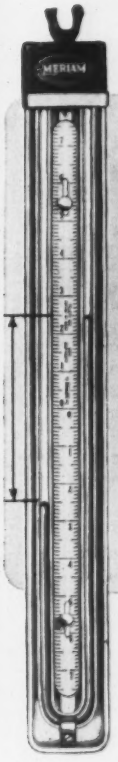
E. F. JOHNSON COMPANY

Waseca, Minn.



JOHNSON

a famous name in Radio



MERIAM Clean-Out MANOMETER

Quickly and Easily Cleaned Without Disconnecting

THIS U-Type Clean-Out Manometer is for checking gas and air pressures from a few ounces up to several pounds. Suitable for either portable service or permanent installation.

The head is quickly removed—with a few turns of the wing nut—permitting quick cleaning of tube, with brush furnished. This feature also adds to its portability. It also allows convenient changing of the indicating fluid (oil, water or mercury).

This Clean-Out Manometer is available in standard ranges from 6" to 50". One of many instruments made by us throughout the past 34 years. Ask for Bulletin 1.

THE MERIAM INSTRUMENT CO.

10958 Madison Avenue • Cleveland 2, Ohio

In Canada: Peacock Bros., Ltd., Montreal

MERIAM *Instruments*

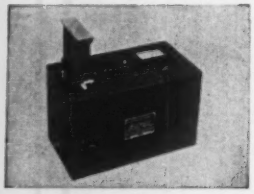
ESTABLISHED 1911

MANOMETERS, METERS AND GAUGES FOR THE ACCURATE MEASUREMENT OF PRESSURES, VACUUMS AND FLOWS OF LIQUIDS AND GASES

Steinlite Moisture Tester

IDEAL FOR PRODUCTION CONTROL

Steinlite No. 105E is designed for testing processed material such as dehydrated vegetables, nuts, cocoa, and other special products. It is perfectly adapted for practically an instantaneous moisture test for production control purposes. A test can be completed in one or two minutes.



The Steinlite electronic moisture tester is fast, accurate and easy to use.

As each step in the process progresses, the moisture may be checked. The instrument can be furnished with a moisture test range from approximately 1% to 35%. It is calibrated against the established laboratory method for the particular material and is guaranteed to check within .25 of 1% of the method against which calibration was made. Sold on free trial basis. No money down. Write for complete details.

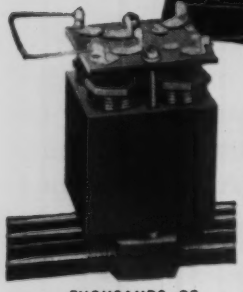
SEEDBURO EQUIPMENT COMPANY

744 CONVERSE BUILDING
CHICAGO 6, ILLINOIS

Low cost gas analysis!

with GOW-MAC EVER-TITE THERMAL CONDUCTIVITY UNITS

ACCURATE...
SENSITIVE...
COMPACT...
RUGGED...



GOW-MAC units provide a rapid, accurate and very inexpensive means of observing gases by the well-known thermal conductivity method. They require no special instruments, only standard accessories found in any laboratory or instrument department.

Typical applications include special atmospheres, gas synthesis, inert gas generation and distribution, efficiency of internal combustion engines and furnaces and wherever hydrogen and CO_2 are found. Units may be used with indicating, recording and controlling instruments. Extremely adaptable to gas flow needs.

Special features of construction result in high sensitivity, excellent stability and long life relatively unaffected by vibration or ambient change. All cells are tested at 10 psi before shipment. Parts are precision machined and assembled without the use of glass or cement.

THOUSANDS OF GOW-MAC UNITS are performing various gas analysis functions in laboratories, petroleum refineries, aircraft carriers, chemical plants and process industries. Write for bulletin, E-47

GOW-MAC INSTRUMENT CO.
22 LAWRENCE ST., NEWARK 5, NEW JERSEY

V_A (He) is of course the volume of the gas at s.t.p. since both V_T and V_R were referred to s.t.p. V_A will of course vary with the pressure P_1. If V_x is designated as the absolute volume of the free space in the adsorption bulb and T_x the temperature of the bath then

$$V_A\ (\text{He}) = \frac{V_x P_1}{T_x} \frac{273.2}{760} \tag{36}$$

or

$$\frac{V_A\ (\text{He})}{P_1} = \frac{V_x}{T_x} \frac{273.2}{760} = \text{constant} = f_A$$

Hence by dividing V_A (He) as obtained in equation (35) by the corresponding pressure a constant is obtained. This constant (f_A) may be termed the adsorption bulb factor. Multiplying f_A by the pressure at any time will give the volume of gas corrected to standard conditions contained in the adsorption bulb. The volumes of all parts of the system are now known and the nitrogen adsorption determinations can now be made.

The helium is first pumped out of the system with the nitrogen bath removed. Stopcock A is then closed and the bath replaced. A dose of nitrogen is then admitted to the burette system and its volume determined in the usual manner. Let this volume be V_T (N_2). The size of V_T (N_2) depends upon the nature and amount of the sample under investigation. The nitrogen is then admitted to the adsorption bulb through the stopcock A. As the gas is adsorbed on the surface the pressure will gradually drop. Sufficient time must be allowed for the adsorption to reach equilibrium. When the pressure has reached a constant value it is recorded. The temperature of the burette must also be recorded and the position of the mercury in the burette. The temperature of the cold bath should be recorded for each reading even though it does not change appreciably. If an oxygen vapor pressure thermometer is being used it should be in place in the bath during the entire experiment. This completes the data necessary to determine the first point.

A second point is obtained by moving the mercury in the burette to the next reference point, thereby decreasing the volume of the system with a corresponding rise in pressure. When the adsorption has again reached equilibrium at this new pressure, the data are recorded and the process repeated until the burette has been completely filled with mercury.

To calculate the volume of gas adsorbed, we know V_T (N_2) and P, T and volume factor (f_v) for each point taken. We also know P_0, the vapor pressure of nitrogen at the bath temperature.

V_T (N_2) = total volume of nitrogen taken

V_R (N_2) = volume of nitrogen remaining in the burette system up to stopcock $A = (P \times f_v)/T$

V_A (N_2) = volume of nitrogen in the free space of the adsorption bulb corrected to s.t.p. $= f_A \times P$. Hence the volume of gas adsorbed V_{Ads} is the difference between the amount taken V_T and the amount remaining in the gas phase $V_R + V_A$, that is

$$V_{Ads} = V_T - (V_R + V_A) \tag{37}$$

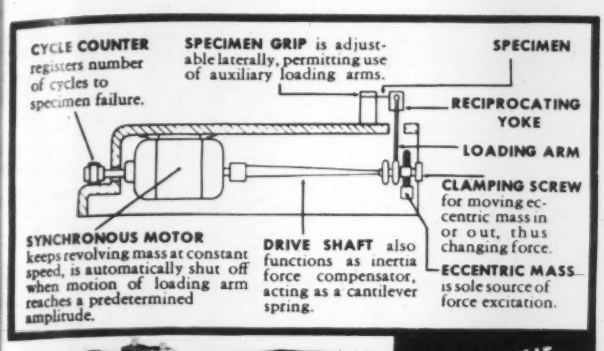
Equation (37) assumes that nitrogen obeys the ideal gas law. Actually it does not and so a correction must be made to equation (37). This correction can be easily applied by multiplying V_A by $1 + (\alpha P/760)$ where α is a constant depending upon the temperature and the gas used. For nitrogen at $-195°$C. α is 0.05. For other gases and temperatures Emmett and Brunauer[4] have listed values of α.

In the plot of the adsorption isotherm it should be noted that the volume adsorbed is plotted against the relative pressure. The relative pressure is simply P/P_0.

Having calculated the volume adsorbed for each of the points taken the total surface area of the sample may now be determined.

Calculation of the Area

As was pointed out with reference to equation (29), a plot of $P/V\ (P_0 - P)$ against P/P_0 should give a straight line whenever equation (28) is a valid equation for the


CYCLE COUNTER registers number of cycles to specimen failure.
SPECIMEN GRIP is adjustable laterally, permitting use of auxiliary loading arms.
SPECIMEN
RECIPROCATING YOKE
LOADING ARM
CLAMPING SCREW for moving eccentric mass in or out, thus changing force.
ECCENTRIC MASS is sole source of force excitation.
SYNCHRONOUS MOTOR keeps revolving mass at constant speed, is automatically shut off when motion of loading arm reaches a predetermined amplitude.
DRIVE SHAFT also functions as inertia force compensator, acting as a cantilever spring.

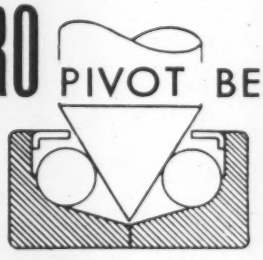
EXCLUSIVE "CONSTANT FORCE" FEATURE

BALDWIN offers—

SONNTAG SF-2 FATIGUE TESTING MACHINE FOR SHEET MATERIALS Small, compact, simple, low cost, bench-mounted testing machine, using the "constant force" principle of loading for fatigue tests on metal, plastic or wood sheet-stock. Eliminates preliminary determinations of modulus of elasticity, and re-calibrations during progress of test. Attendant not required; machine stops when specimen fails, and counter retains record of cycles. Ask for bulletin 256. The Baldwin Locomotive Works, Philadelphia 42, Pa., U. S. A. Offices: Philadelphia, New York, Boston, Norfolk, Birmingham, Houston, St. Louis, Chicago, Cleveland, Detroit, San Francisco, Washington, Pittsburgh, Seattle.

HEAVY THRUST LOADS

MICRO PIVOT BEARINGS



An extra-small unit providing:

High load capacity
(Thrust, Radial, combined)

Lowest Friction

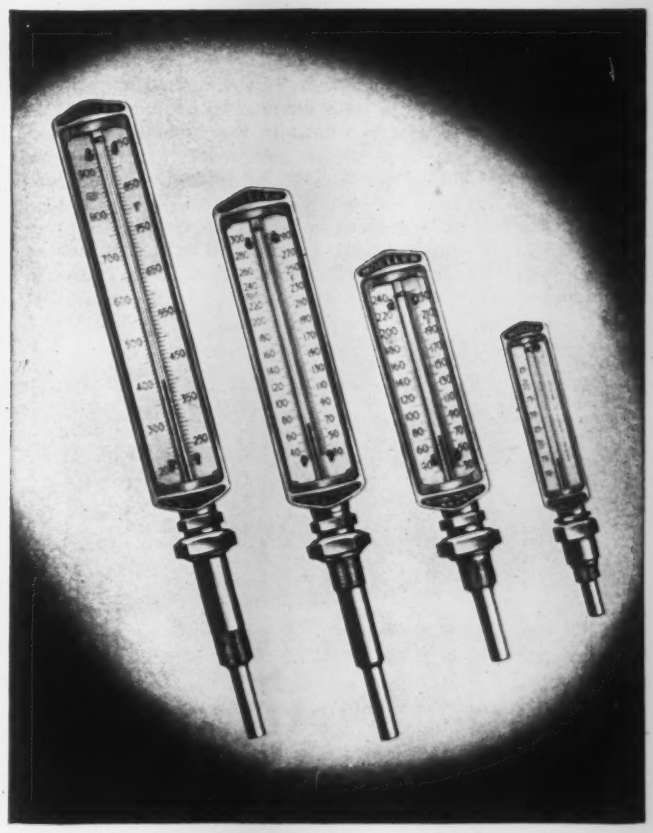
Precision Tolerances

Dust Shield

Unaffected by Misalignment

PIVOT BEARINGS	RADIAL BEARINGS
5/32" to 3/8"	1/4" to 3/8"

NEW HAMPSHIRE BALL BEARINGS, Inc.
8 MAIN STREET • PETERBOROUGH, NEW HAMPSHIRE, U. S. A.



MOELLER

INDUSTRIAL THERMOMETERS

. . . Built upon Four Generations of

GUARANTEED ACCURACY

- Engineered to meet the exacting demands of modern science and industry.
- Designed with the exclusive, patented Moeller Red Reading Glass for quicker, easier reading.
- Sturdily constructed to assure years of lasting satisfaction.
- Available in 5, 7, 9 and 12 inch cases, with fixed or separable socket connections, in straight and angle form, with any desired scale range.

For 80 years Moeller Products have set the standard of accuracy in the design and manufacture of temperature indicating, measuring and recording instruments. Send for the new Moeller Catalog, now on the press, and literature covering —

INDUSTRIAL, LABORATORY AND RECORDING THERMOMETERS
THERMOSTATS • HYGROMETERS • HYDROMETERS • PSYCHROMETERS
and MARINE SPECIALTIES

MOELLER INSTRUMENT COMPANY

132nd STREET and 89th AVENUE — RICHMOND HILL, NEW YORK

OFFICES IN PRINCIPAL CITIES

isotherm. It has been found from the examination of a great many "S" shaped isotherms that equation (28) does fit the data and hence a plot of equation (29) is linear over the relative pressure range 0.05 to 0.3 or higher. Below and above these limits the data deviate from linearity. The procedure then is to plot the data in the form of equation (29) and select the best linear portion. From the slope and interception of this line V_m can be determined by equation (31) and the area by equation (32).

Since equation (29) seldom holds above a relative pressure of 0.35 it is not necessary to plot the data obtained at higher pressures and unless one is interested in the isotherm for purposes other than the calculation of the area it is not necessary to obtain data above this point. It may be noted that

$$\frac{P}{V\,(P_0 - P)} = \frac{P/P_0}{V\,(1 - P/P_0)}$$

which is a more simple function to calculate since P/P_0 must be calculated anyway for the right side of equation (29).

Various Refinements

Having described the essential features of a gas adsorption apparatus and discussed its operation, we will now describe certain improvements which, although not essential, will increase either the accuracy of the data or the ease of operation of the apparatus.

Since any impurity occurring in either the nitrogen or helium gas used in the apparatus may seriously affect the results, purification of these gases before they are stored in the reservoirs is highly desirable. The most serious impurities that are likely to occur in ordinary tank gases are moisture and oxygen or, in the case of helium, nitrogen may also be an impurity.

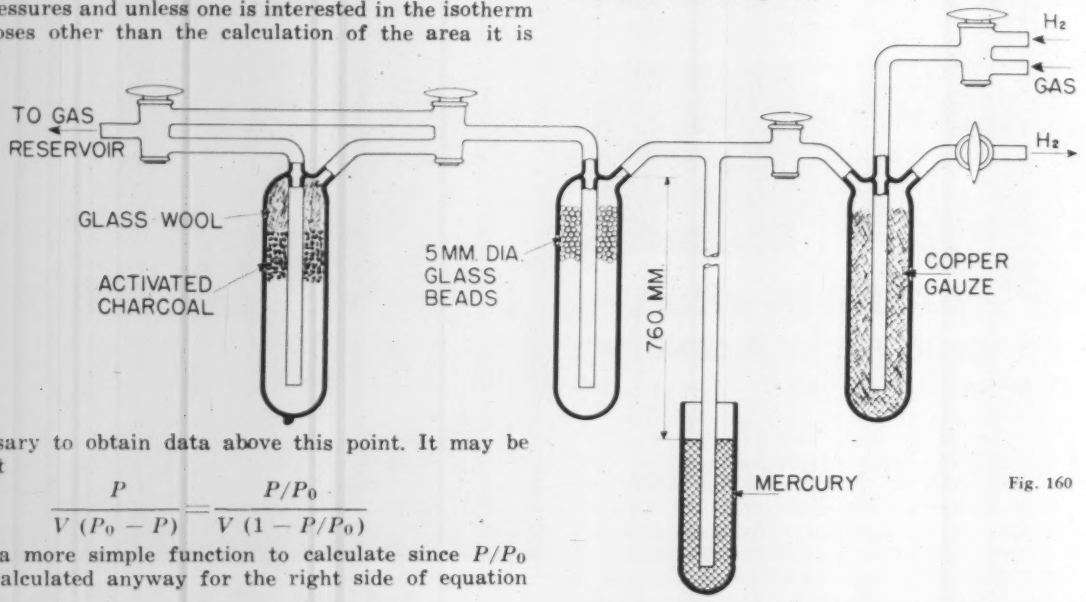


Fig. 160

Passing the gas over reduced copper at about 350°C. will remove all but the last few hundredths of a percent of the oxygen*. A trap filled with glass beads and cooled in liquid nitrogen makes a very effective drying tube. All gases but the inert gases may be removed from helium by passing it over activated charcoal also cooled to liquid nitrogen temperatures. A simple flow system which may be attached permanently to the gas inlet tube (see Fig. 157) is shown in Fig. 160. This arrangement permits all parts of the gas train to be evacuated before the gas is introduced. The depth of the relief tube in the mercury regulates the maximum pressure at which the gas may be stored in the reservoir.

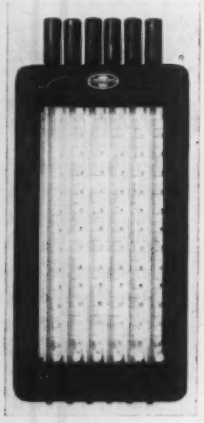
To be continued

*In spite of the statement in most books on the subject hot reduced copper will not reduce the oxygen content of a gas below about 0.05%. In fact it is extremely difficult to obtain nitrogen completely free of oxygen. Where the matter is critical, lamp grade nitrogen such as is used for filling incandescent lamps should be used. Ref. Exline, Kramer and Bowman; *Journal Institute of Petroleum*, Vol. 29, 1943, page 301.

REFERENCES

3. Farkas and Melville, Experimental Methods in Gas Reactions, McMillan Company (London), 1939, page 104.
4. P. H. Emmett, S. Brunauer, *Journal of the American Chemical Society*, Vol. 59, 1937, page 1553.

Here's a multiple tube manometer that takes up 30% less space



Important to manufacturers whose laboratory space is limited are Trimount Multiple Tube Manometers. With a center-of-tube to center-of-tube measurement of only one inch, overall width is nearly one-third less than that of ordinary multiple tube manometers. Available with any number of tubes to suit your requirements and in a choice of mountings, Trimount Multiple Tube Manometers offer such features as—adjustable mercury index . . . welded steel construction . . . easy to read scales . . . plate glass cover . . . black crinkle finish. Write for complete details.

TRIMOUNT INSTRUMENT COMPANY
37 W. VAN BUREN ST. CHICAGO 5, ILLINOIS

Special for Our Readers
ONE DOLLAR (Regularly $2)

Elementary Engineering Electronics
With Special Reference to Measurement and Control

By ANDREW W. KRAMER

Managing Editor *Power Plant Engineering*, Member American Institute of Electrical Engineers, Associate member Institute of Radio Engineers.

Cloth, 344 pages, 259 illustrations, $1 postpaid.

ORDER THIS UNIQUE BOOK NOW

Check, money order or cash must accompany order.

Instruments Publishing Co.,
1117 Wolfendale St., Pittsburgh 12, Penna.
Enclosed is $.....for.....copies of Kramer's ELEMENTARY ENGINEERING ELECTRONICS (at $1 each).
Name .....
Address .....

Money going up the flue?

MAKE YOUR OWN CO_2 TEST

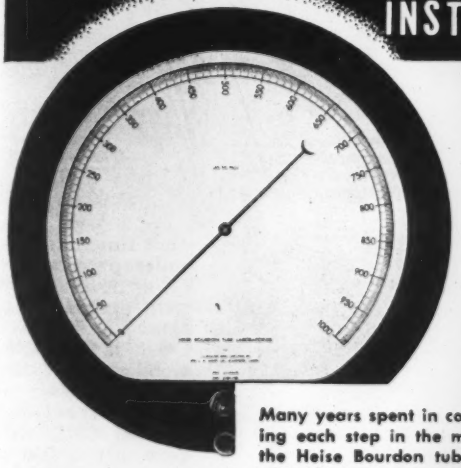
You can get an accurate CO_2 reading in 30 seconds—and in 3 or 4 minutes a complete analysis including draft and flue gas temperature, by this handy, accurate Hays Combustion Test Set.

Reveals efficiency of combustion—tells how much money is going up the flue.

A new booklet "ABC of CO_2" is important reading—permits you to figure actual fuel loss. Write for it.

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

DEAD WEIGHT TEST . . . INSTANTLY



Many years spent in constantly refining each step in the manufacture of the Heise Bourdon tube makes possible the extreme accuracy guaranteed for each gauge which is to within ½ of 1% of the load at any point of the scale.

THE STANDARD OF THE WORLD

RANGE FROM 0-15 TO 0-16,000 P.S.I.

8½" DIAL 151.80
12" DIAL . . . . . 165.60 to 172.80
16" DIAL . . . . . 194.00 to 201.20

HEISE BOURDON TUBE LABORATORIES
BROCK ROAD NEWTOWN, CONNECTICUT
IN COLLABORATION WITH THE A. H. EMERY COMPANY

STEWART-WARNER'S NEW

South Wind TRAILER HEATER

. . . . uses CHACE Thermostatic Bimetal

This miniature central heating plant provides *automatic* heat control to owners and manufacturers of trailers. The compact and efficient unit delivers 14,000 BTU per hour, ample for the coldest days. The even heat flow is maintained automatically by a quiet, high-powered blower which forces heated air through ducts, furnishing constant, even warmth from floor to ceiling.

The South Wind Model 977-D Trailer Heater operates on 110 volt AC circuit, burns vaporized gasoline. The combustion chamber is stainless steel, hermetically sealed for clean, odorless operation with complete safety. An automatic thermostatic control, in which Chace Thermostatic Bimetal is the actuating element, regulates the heat output to achieve a steady desired temperature. Then, too, the automatic overheat switch, an important safety factor in South Wind Trailer Heaters, based on the reliable action of Chace Thermostatic Bimetal, is precision manufactured for unfailing dependability and accuracy. Chace Thermostatic Bimetal is available in sheets, strips or finished forms for many types of temperature responsive devices.

W. M. CHACE CO.
Manufacturers of
Thermostatic Bimetals
1609 BEARD AVE. • DETROIT 9, MICH.

The Month's NEW INSTRUMENTS

In this department we report each month new devices for measurement, inspection, testing, metering and automatic control—in the form of concise technical descriptions.

FOR FURTHER INFORMATION USE THE POSTAGE-FREE ORDER CARD ON PAGE 581.

Direct-reading pH Meter

New "Industrial Model" line-operated direct-reading pH Meter, designed and built for production as well as laboratory applications, is conveniently portable (weight 10 lbs.) for making spot checks of sample solutions. Case dimensions, 7" × 8½" × 11¼". For continuous process indication, hooks on back of case permit installation over a vat, hanging from a rack, or wall mounting; and special length lead wires can be furnished to permit remote installation. For usual tests of small samples, electrode assembly is mounted on inner side of a compartment door, protected from damage when meter is carried. Completely shielded glass electrode can be used directly in grounded solutions.

Only two simple operating adjustments are needed for standardization. Extremely high stability is said to have been obtained by improved design of electronic circuit and of galvanometer movement: recalibration seldom required oftener than once a week. Compensation is automatic for variations in solution temperature from 0° to 100°C. and for changes in ambient temperature; a voltage regulator corrects for a-c. line fluctuations from 100 to 130 volts. Inclined scale facilitates easy reading. Operation being simple, an unskilled production worker can make quick and accurate pH determinations. —*Cambridge Instrument Co., Inc., 3742 Grand Central Terminal, New York 17, N. Y.*

Please mention number 601 when filling out card

Ultrasensitive Electrical Tester

New "Beckman UltrOHMeter" is for precision measurements of unusually small currents and high resistances. Current sensitivity to as low as 2×10^{-13} ampere full-scale permits resistances as high as 10^{16} ohms to be measured directly. Announcement states that "it is no longer necessary to extrapolate from high-voltage tests." Built-in standard voltage source for resistance measurements provides steps from 0.5 to 20 volts and instrument is so designed that resistor linearity tests and polarization checks can be made conveniently. By use of voltage feedback, time response of instrument is maintained at approx. 2 seconds despite use of input resistors varying from 10^6 to 10^{11} ohms. "UltrOHMeter" can also be used as a high-impedance d-c. voltmeter with sensitivities from 20 mv. to 5 volts with a maximum of 10^{11} ohms input impedance. Other features: Internal resistor calibration means, 23 ranges, minimum current sensitivity of 5 microamperes, minimum resistance of 100,000 ohms, instrument completely battery-operated.—*National Technical Laboratories, 820 Mission St., South Pasadena, Calif.*

Please mention number 602 when filling out card

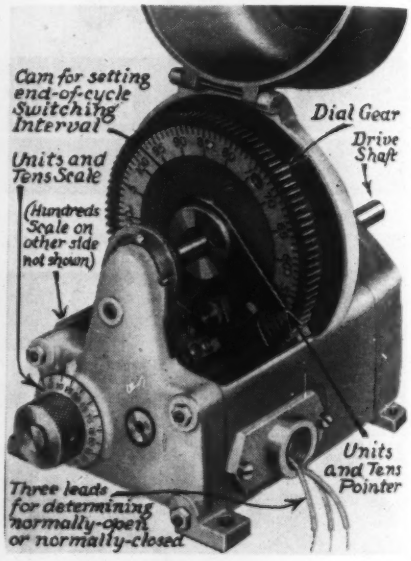
Frequency Meter

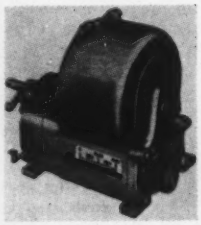
New "Model MJ-9 Amateur Frequency Meter" is designed for checking frequencies of FM or AM amateur transmitters operating in any band from 3.5 to 148 Mc. Bands covered are 3.5-4.0, 7.0-7.3, 14.0-14.4, 20.5-21.5, 28.0-29.7, 50-54 and 144-148 Mc. A 500-kc. crystal-controlled oscillator is used as a reference standard. Over-all accuracy, 0.05% at all frequencies. "Model MJ-9" may be used with a following class A amplifier as a substitute for crystal oscillator in an amateur transmitter to provide variable-frequency operation.—Dimensions, 7" × 10" × 6½"; weight, 7½ lbs.—*Browning Laboratories, Inc., Winchester, Mass.*

Please mention number 603 when filling out card

Automatic Process-cycle Controller

New "Cyclo-Monitor" is a process-program controller which opens and closes circuits on the basis of pre-determined counts of strokes or revolutions


Cam for setting end-of-cycle Switching Interval
Dial Gear
Drive Shaft
Units and Tens Scale
(Hundreds Scale on other side not shown)
Units and Tens Pointer
Three leads for determining normally-open or normally-closed



(not time intervals unless process drive is synchronized with standard a-c. time). "Model CMR" is for revolutions and performs equally well in either direction; "Model CMS" differs only in that it is furnished with a short lever for stroke actuation. Each provides a two-part control cycle which may be repeated indefinitely: first part "on" (or "off") during which main dial gear turns in one direction; and second part "off" (or "on"), known as "switching interval," during which main dial gear turns in opposite direction. Maximum of cycle count is 4,000; maximum "switching interval" is 20 units and minimum one-half unit. Switch rating, 125-v. 10-a., 250-v. 5-a., 460-v. 3-a.—*Counter and Control Corp., 2737 S. 28th St., Milwaukee 7, Wis.*

Please mention number 604 when filling out card

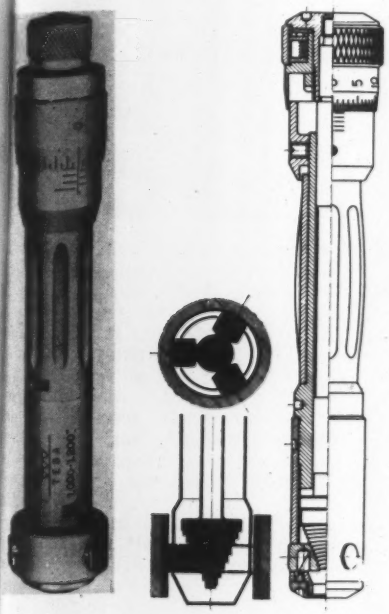
Small Tubular Capacitors

New "68P" and "69P" "Midget" (trademark) paper dielectric capacitors operate at 85°C., have ample humidity protection for normal radio and other uses, embody new materials and processes resulting from maker's engineering of small capacitors for the proximity fuse and other miniature wartime assemblies, meet proposed RMA humidity and voltage tests. Type "69P" capacitors have side leads to allow wiring them across sockets of miniature tubes; "68P" units have conventional end leads.—*Sprague Electric Company, North Adams, Mass.*

Please mention number 605 when filling out card

Internal Micrometer

New "Imicro" Swiss internal micrometer employs three-point measuring principle, allows direct reading to 0.0005" and distance between graduations enables interpolation. Centrally-supported rotatable measuring spindle ends in tapered thread which pushes outwards three feeler bolts lying in a plane perpendicular to axis, until they

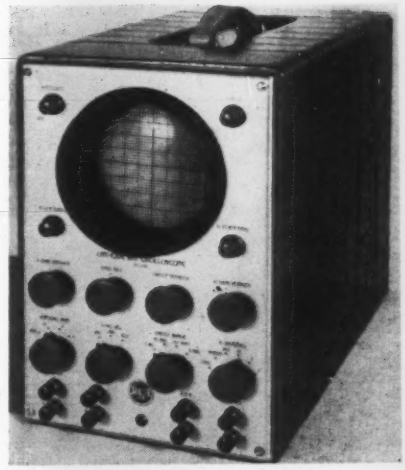


come into contact with wall of bore. For best possible centering, feelers are located at 120°. Uniform pressure is obtained by ratchet which also produces slight vibrations allowing instrument to adjust itself in hole to be measured. Standard set comprises enough inside micrometers to cover total measuring range of set. Set "No. 1092," range 0.5"-0.8" (3 instruments); "No. 1093," 0.8"-1.6" (4 inst.); "No. 1094," 1.6"-4.0" (6 inst.).—*Maveg Machine Sales Ass'n, Inc., 24-16 Bridge Plaza South, Long Island City 1, N. Y.*

Please mention number 606 when filling out card

Interchangeable Plug-in-tube Cathode-ray Oscilloscope

New "Type WO-60C" portable cathode-ray oscilloscope, first to permit quick interchange of three different types of cathode-ray tubes, is a general-purpose instrument built rugged for

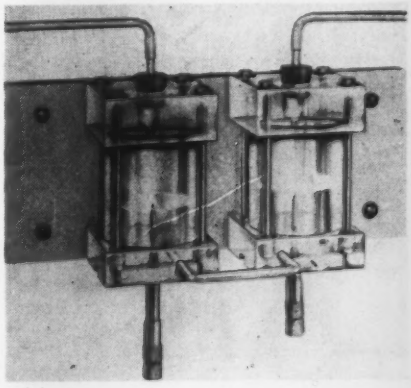


industrial applications. It handles input voltages as high as 850 volts peak to peak, permits observation of waveforms of 0.5 to 300,000 cps. Furnished with "WO-60C" is a medium-persistence cathode-ray tube for general applications. For lowest frequencies, a long-persistence flickerless screen is desirable. A third tube, having a short-persistence highly-actinic screen, is best for photographic recording without blurring. Latter two tubes are available as accessories. Changeover from one tube to another takes as little as ten seconds, is accomplished by detaching light shield, removing tube and plugging-in another. New oscilloscope is self-contained, weighs 31 lbs. It comprises high-gain amplifiers, calibrated attenuators, oscillators, and internal high- and low-voltage power supplies. Regulator tubes stabilize critical voltages. Horizontal and vertical amplifiers have practically identical electrical characteristics, special cathode-coupled input stages giving low-capacitance high-impedance input, permitting rapid change of gain without surges and preventing signal from shifting or leaving screen. This stability aids visual examination and especially photographic recording. Gain is manually adjustable without distorting wave-shape or altering frequency or phase characteristics. —*Test and Measuring Equipment Section, RCA Victor Division, Camden, N. J.*

Please mention number 607 when filling out card

Precision Hook Gage

New "Dwyer Transparent Hook Gage" is said to exceed in accuracy any in its class yet invented, utilizes prin-



ciple of water-column U-gage. Capillarity effect ordinarily encountered in gages of this type has been overcome by widening columns to $2\frac{1}{2}$". Measurements are taken from center of column by hooks attached to depth micrometers of a standard make, reading to 0.0005" over a 2" range. Manufacturer explains that use of standardized parts keeps instrument in moderate-price field and permits added uniformity and dependability. Except for hooks and micrometers, gage is made of an unbreakable transparent plastic, may thus be read easily and its operation checked at a glance. Provision has been made for rapid disassembly and cleaning. Principal use of precision hook gage will be checking other instruments; also for measuring any steady pressure within its scale range to 0.0005" water column.—*F. W. Dwyer Mfg. Co., 317 South Western Ave., Chicago, Ill.*

Please mention number 608 when filling out card

Analyzer for Electrical and Electronic Apparatus

New "Model 769 Electronic Analyzer" provides facilities for voltage, current and resistance measurements covering

frequency ranges of practically all present electronic applications. It comprises a completely stable high-frequency VTVM for measurements on frequencies up to 300 Mc., an electronic volt-ohmmeter, and a complete 10,000-ohm-per-volt d-c. and 1000-ohm-per-volt a-c. multimeter. Use of a new type unity-gain d-c. amplifier, incorporating both regeneration and degeneration, achieves remarkable stability of VTVM and volt-ohmmeter circuits. "Model 769" is completely line isolated and line insulated to reduce external r-f. influence. R-f. probe, equipped with a flexible cable for plugging into front panel, is of Bakelite and Polystyrene construction with a minimum exposed metallic area, and completely isolated from any d-c. potential influence. Analyzer section provides complete versatility of measurement: six 10,000-ohms-per-volt voltage ranges, six rectifier type a-c. voltage ranges to 1200 volts, three ohmmeter ranges to 200,000 ohms, and six d-c. ranges to 600 ma. A special d-c. probe containing a 5-megohm resistor measures d-c. potentials with minimal insertion effect. Standard test leads also are provided. Power supply is self-contained; no external a-c. supply is required when using "Model 769" as a

STATHAM WEIGHING RINGS

Remote indication or recording of large forces is easily accomplished with Statham Weighing Rings. Made to suit your particular requirements, they may be had in ranges to 10,000 pounds. A variety of connections may be specified to permit use of the Rings in tension, compression, or both. Their output is sufficient for direct operation of simple D-C meters, or of high speed recording galvanometers or oscillographs without the need for expensive electronic equipment.

Consult our Engineering Department concerning your problem.

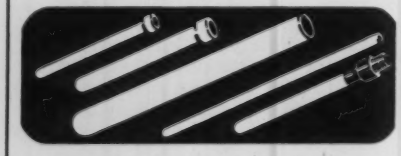
Write for Our Catalog.

STATHAM LABORATORIES SCIENTIFIC INSTRUMENTS

8222 BEVERLY BOULEVARD
LOS ANGELES 36, CALIF.

MONTGOMERY TUBES

for Thermocouple Protection or for Radiant Target Sighting



Montgomery high refractory tubes, porcelain, mullite and corundum, are widely used in applications above 2000°F. They are available in all popular and special sizes.

We also manufacture Crucibles for laboratory analysis. Tell us your requirements.

WHEATSTONE CORPORATION

Manufacturers of refractory porcelains

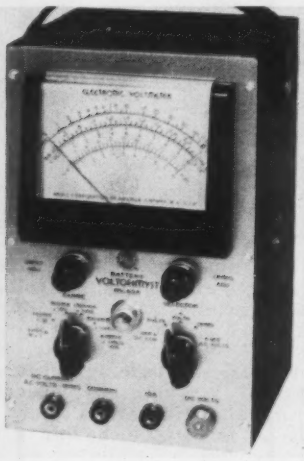
2436 READING RD., CINCINNATI 2, O.

standard analyzer. Solid oak case, 10" × 13" × 6⅛".—*Weston Electrical Instrument Corp., Newark 11, N. J.*

Please mention number 609 when filling out card

Volt-ohm-ammeter

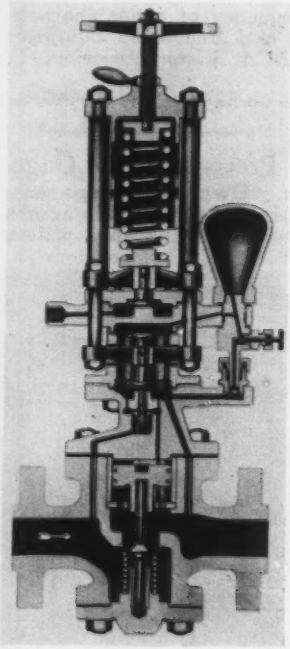
New "Type WV-65A Battery Volt-Ohmyst," is a self-contained lightweight vacuum-tube voltmeter operating independently of any external power source, so that it can be used for servicing equipment in automobiles, airplanes, boats, in rural areas, in industrial electronic applications, etc. It incorporates best features of maker's conventional model "VoltOhmyst," measures 9⅝" high × 6¾" wide × 6¾" deep; has five a-c. and six d-c. voltage ranges to 1000 volts, six ohmmeter ranges to 1000 megohms and six ammeter ranges to 10 amperes.—*Test and Measuring Equipment Section, RCA Victor Division, Camden, N. J.*



Please mention number 610 when filling out card

Pump Governor

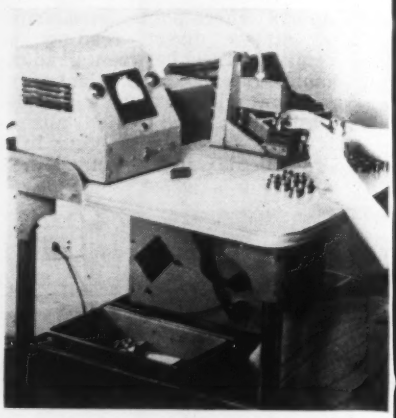
New line of pump governors, specially designed for close control and to resist the ravages of wear and erosion, feature hard-surfaced seat rings, 80 Brinell hardened stainless steel main valve and 500 Brinell cylinder liner. Other design features include wide spring range which permits setting without change of spring or diaphragm, single-seated valve, no packing or stuffing boxes, interchangeability of replacement parts without removal of the body from the line. Available in sizes from ½" to 4" for inlet pressures from 40 to 600 lbs./in.² at temperatures to 750°F.—*Leslie Co., 225 Delafield Ave., Lyndhurst, N. J.*



Please mention number 611 when filling out card

Automatic Gage and Sorter

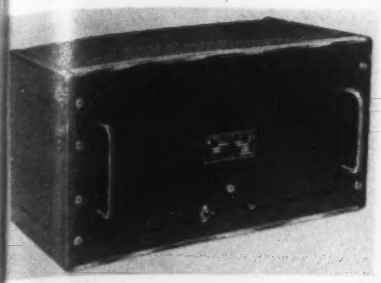
New "Model DS-20 Selector" is an automatic inspector-segregator for sorting small parts into three classifications: oversize, acceptable and undersize. Accurate to 0.000,01", "Selector" will sort parts with tolerances from ±0.0001" to ±0.005" at speeds up to 12,000 parts per hour. It comprises three units; gage head, master control and segregator. It is said that because of unique electric circuit, speed of operation is limited only by feeding-rate of parts. Fully-automatic and semi-automatic feed mechanisms are available. "Model DS-20" comes as a "packaged unit" ready for operation. By using gage blocks it can be set in a few minutes. Master control unit has red and green indicating lights, also an electric gage which provides visible readings of size of each part being sorted, and which is sealed against dust and moisture. Available accessories: (1) an electrical counter for counting acceptables and rejects; (2) a hearing aid which makes possible efficient operation of "Selector" by a blind person. "Selector" can also be adapted for measuring internal dimensions, for simultaneous checking of more than one dimension or for sorting into more than three classifications. Besides "Model DS-20," three other "packaged units" are available. — *DoAll Co., 1301 Washington Ave. South, Minneapolis 4, Minn.*



Please mention number 612 when filling out card

Voltage Regulator

New "Stabiline Type IE" (Instantaneous Electronic) voltage regulator is said to provide instantaneous correction of line voltage fluctuations with negligible wave-form distortion. Output voltage is held to within ±0.1 volt of any set value between 110 to 120 volts for an input line voltage change from 135

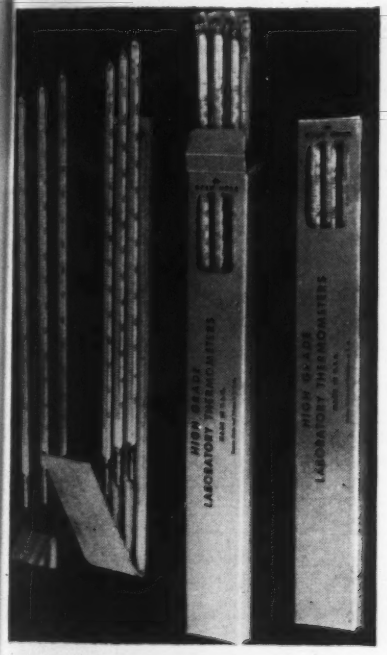


to 95 volts. Time for recovery depends on line voltage, load current, load power factor and other conditions, but usually is 3 to 6 cycles. Performance is not affected by any load change from zero to full rating of unit, is independent of any load power factor change from 0.5 lagging to 0.9 leading. Wave-form distortion under all adverse conditions never exceeds 3% and for most operating conditions is between 1% and 2%.—*The Superior Electric Co., 531 Laurel St., Bristol, Conn.*

Please mention number 613 when filling out card

Laboratory Thermometer Sets

New sets of three laboratory thermometers come in an entirely new shipping carton said to save half the weight



and half the volume of conventional methods and provide greater shipping and storage protection. Another advantage is that window in outer container facilitates stock recording without opening.—*H-B Instrument Co., Inc., 2518 North Broad St., Philadelphia 32, Pa.*

Please mention number 614 when filling out card

Photoelectric Densitometer

New "Precision Densitometer" supersedes maker's previous models, is said to permit exact determination of light transmission through photographic negatives and other semi-opaque objects, and to be especially suited to requirements of photographers, lithographers, and laboratories requiring absolute precision in their work. New color printing

This is truly a practical D. C. amplifier! It opens new uses for your Brush Direct-Inking Oscillograph. As with all Brush products this new instrument represents years of intensive research in engineering and design. Write today for the complete story . . . Brush representatives will be glad to demonstrate.

Specifications include

- **Frequency Response**—uniform from D. C. to 100 cycles per second
- **Voltage Gain**—1000 Approximately (one chart millimeter pen displacement per millivolt signal)
- **Stability**—drift—less than one chart mm. per hour
- **Calibration Circuit**—for convenient determination of input signal levels
- **Centering Control**—to position pen electrically to any point on chart
- **Power Requirements**—115 volts, 60 cycles
- **Portability**—Weight 30 pounds

a product of

The Brush Development Co.

3419 Perkins Ave.
Cleveland 14, Ohio

Canadian Representatives:
A. C. Wickman, (Canada) Ltd., P. O. Box 9, Station N, Toronto 14

TEST YOUR MAGNETIC CIRCUITS

RAWSON FLUXMETER TYPE 504

The only portable fluxmeter available which returns rapidly to zero when a single button is depressed. Simple and fast in operation. Convenient and light in weight.

Not limited to a single type of measurement. Has universal application for laboratories or production. Measures strength of magnets and electromagnets, permeability and hysteresis loops for iron and steel, total flux lines in circuit, flux lines developed in air gap, etc.

Has a mechanical clamp to protect the pivots and jewels when in transit.

Low price $125 net FOB Cambridge, Mass

RAWSON ELECTRICAL INSTRUMENT COMPANY

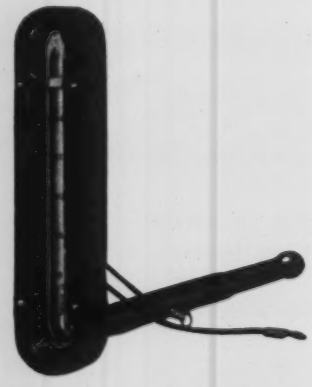
112 POTTER STREET, CAMBRIDGE 42, MASS.

Representatives

CHICAGO NEW YORK CITY LOS ANGELES

For Extremely Close Temperature Control

Visual-Stats



Extreme sensitivity is easily attainable. Mercury column visible at control point (where most important) because electrodes terminate at back of tube. No encircling metal bands. Available in angle form.

Send for Cat. 110

The Philadelphia Thermometer Co.

Sixth & Cayuga Sts. -:- Philadelphia

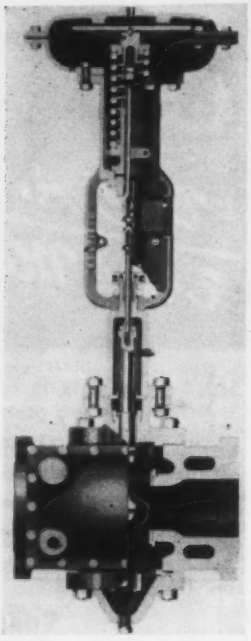
Oldest Thermometer Manufacturer in Philadelphia

methods require such precision. Range of negative densities, 0 to 3.0 with uniform scale and sensitivity and with readings to less than 0.005 density units. Smooth top offers ample space for large negatives. A ¾" illuminated finder disk which makes it a simple matter to locate exact area in negative: when pick-up arm is lowered, finder disk goes dark and measuring beam of light is only 1/16" in diameter. Operation is simple. Density is read directly. Balanced vacuum photocells give stability and eliminate line voltage effects. Densitometer weighs 15 lbs., measures 14" × 14" × 8" high; operates on a.c.—*National Photocolor Corp., 305 East 43rd St., New York 17, N. Y.*

Please mention number 615 when filling out card

Diaphragm-motor Valve

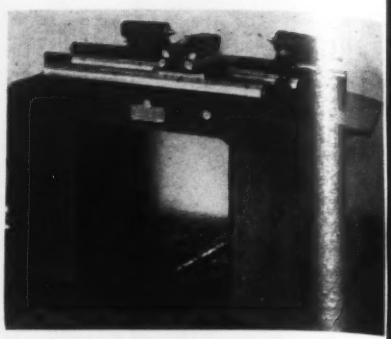
New "No. 700 B" packless bellows-sealed diaphragm-motor valve is designed for service where it is imperative to avoid leakage of the controlled fluid. Bellows-seal assembly has been designed as an integral unit which can be easily detached from valve stem without disassembly of valve body. Operating conditions and nature of flowing fluid determine selection of bellows material. For highly viscous fluids, steam-jacketed bodies, with or without steam-jacketed bellows and radiation fins, are available upon specifications.—*H. Belfield Co., Broad St. at Hamilton, Philadelphia 23, Penna.*



Please mention number 616 when filling out card

Thread-lead Tester

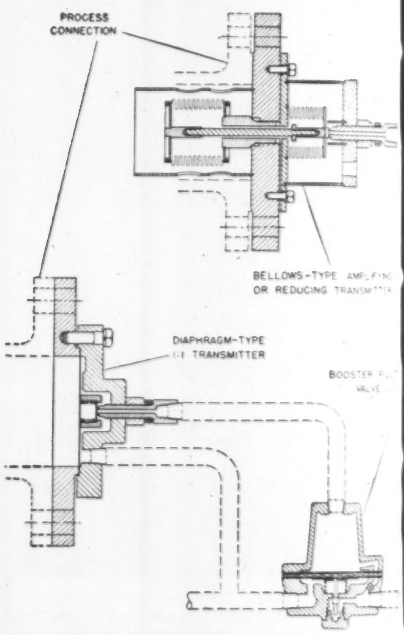
New "Model C Electro-Mechanical Lead Tester" takes workpieces up to 10" in diameter and 30" long between tailstock centers. Work longer than 30", ranging from ½" to 3" in diameter, can be checked easily using V-block work supports. Measuring head is a P&W Supermicrometer Headstock with a 1" spindle travel. Spindle is graduated in increments of 0.050". Dial has 50 graduations of 0.001" each, with a vernier to 0.0001". Thread locating head is an "Electrolimit" universal circuit hea with ball point holder and ball point Cross slide, which carries thread locat ing head, is a spring-loaded devic which gives correct gaging pressure o ball point when centered in thread, re gardless of work diameter and pitch Carriage is equipped with a counter weight which keeps pressure against end measures and measuring head con stant.—*Pratt & Whitney Div., NBI West Hartford 1, Conn.*



Please mention number 617 when filling out card

Pressure Transmitters

New amplifying and reducing model of "Nullmatic" pressure transmitter for liquid level and pressure applica tions are announced. Bellows-type in struments are designed to measur process pressures in ranges as small as 1 lbs./in.² or as large as 200 lbs./in.² and to transmit a range of air pres sures which suit standard pneumatic receivers. Diaphragm-type instruments measure process pressures up to 6 lbs./in.² and transmit air pressures in a 1:1 ratio. All transmitters operate on pneumatic null balance principle as shown in diagram: booster pilot maintains a constant differential pressure across pilot nozzle in transmitter, to balance bellows or diaphragm at essentially a "null" position for all values of process pressure. This pneumatic force-balance operation is said to result in high-speed linear transmission. High

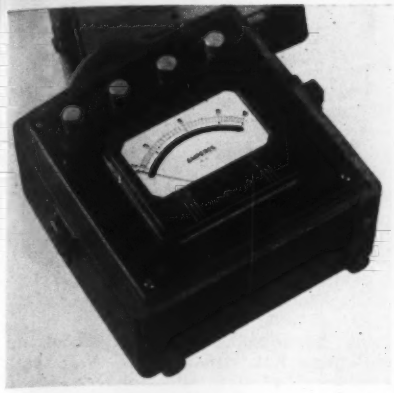


overload protection is provided. Corrosion-resistant materials are available. All units can be furnished for mounting on standard flanges or provided with a pressure chamber.—*Moore Products Co., H & Lycoming Streets, Philadelphia 24, Pa.*

Please mention number 618 when filling out card

Portable Electrical Instruments

New "Model 77-M" portable a-c. voltmeters, ammeters, single-phase and polyphase wattmeters, etc., operate on

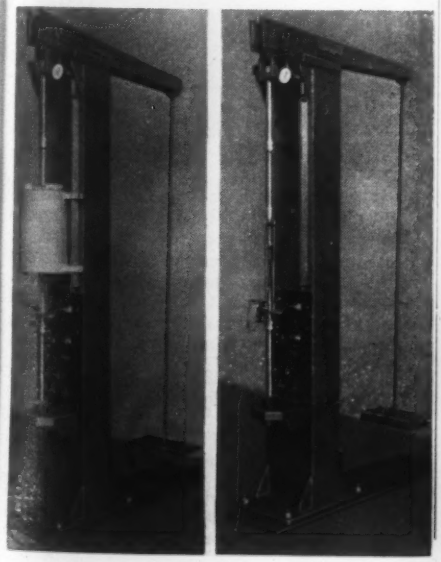


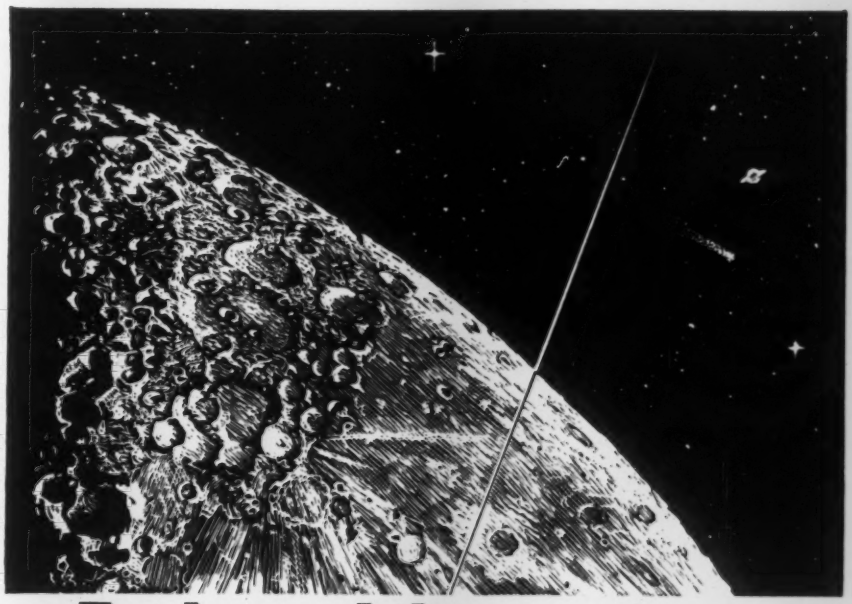
electrodynamic principle, have knife-edge pointers and 3½" mirror scale, magnetic damping and other refinements. Accuracy is 0.75% of full-scale value. Dimensions, 8" × 8" × 5¾" (polyphase wattmeter 8" × 8" × 7¼"). Some instruments are triple-range. Shunts, transformers and other high-grade accessories are available. New instruments, now available separately in mahogany cases, have heretofore been components of maker's "Electrical Power Analyzer."—*Niagara Electrical Instrument Co., 559 Ellicott St., Buffalo 3, N. Y.*

Please mention number 619 when filling out card

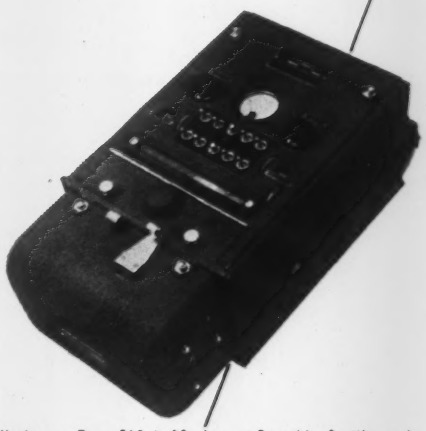
Creep-test Apparatus

New creep testing machine is of lever arm type, 12,000-lb. capacity, accuracy guarantee within 1% of load. Strain indication is by extensometer, is read directly to 0.000025" on a motor-driven revolution counter by means of a follow-





Far beyond the moon...



Hathaway Type S12-A 12-element Portable Oscillograph
• Very small • Automatic • Simple to operate

ONE OF A COMPLETE LINE OF RECORDING OSCILLOGRAPHS AND HIGH-SPEED GRAPHIC INSTRUMENTS

Men talk of trips to the moon nowadays but science has already travelled far beyond in its search for truth . . . from inconceivable distances come faint glimmerings that reveal secrets of distant universes.

Just as these messages from space are interpreted by MEASUREMENTS, so has every scientific discovery resulted from our ability to build and to use ACCURATE MEASURING INSTRUMENTS.

To keep abreast with the ever-changing needs of modern research, Hathaway engineers are constantly working on new measuring instruments, constantly improving older ones. Whatever may be YOUR new problem in MEASUREMENT OR CONTROL, Hathaway experience can help you.

WRITE FOR TECHNICAL BULLETIN SP-167B

Hathaway
INSTRUMENT COMPANY
1315 SO. CLARKSON STREET • DENVER 10, COLORADO

Automatic
ELECTRIC PRODUCTS

TIME SWITCHES

Ruggedly constructed *Automatic* Switches have visible dial in tamper proof compact cabinet . . . pure silver contacts . . . 2 to 24 "on" and "off" operations. For any load . . . for every installation an *Automatic* time switch or Interval Timer will deliver superior performance.

Synchronous or Manually Wound

FLASHERS

Automatic heavy duty, motor driven Flashers available in circuit arrangements for every conceivable effect. Pure silver contacts. Models for any load or purpose.

Alternates *Chasers* *Spellers*

RELAYS

Automatic manufactures a complete line of dependable relays for industrial, business machines, radio, electronic and many other uses . . . open, or can type with tube-base, plug-in features.

Consult our Engineering Department

WRITE FOR SPECIFICATIONS AND INFORMATION TODAY

In Switches, Flashers and Relays where dependable performance is paramount, look for the "Diamond Seal for Diamond Quality".

WRITE TODAY!

AEMCo
Automatic Electric MFG. CO.
58 STATE ST., MANKATO, MINNESOTA

QUIK-LABELS
CODE CARD SYSTEM

Removable Self-Starter Strip exposes ends of Labels for you to peel!
DON'T PICK. USE SELF-STARTER STRIP TO PEEL LABELS.
FREE SAMPLES
DON'T PICK. USE SELF-STARTER STRIP TO PEEL LABELS.
1 PEEL
2 APPLY
3 IDENTIFY
LIKEWISE ON FLAT SURFACES
*Patents Pending

QUIK-LABELS
Mark Your Wires Faster

QUIK-LABELS code Wires, Leads, Circuits, Relays, Parts, etc., faster and cheaper. • Pre-cut to exact size, QUIK-LABELS come on handy cards. • Ready to use, they stik-quik without moistening, replace slow and costly string tags, roll tapes, decals, stencils, metal tabs, etc. • Silicone plastic coated to resist dirt, grease, abrasion. • *Self Starter Strip automatically exposes ends of Labels for you to grasp instantly—no more finger-picking.

Write for Folder and FREE Sample Cards

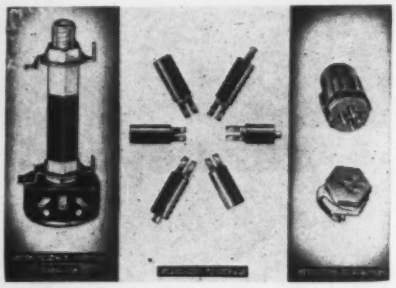
W. H. BRADY COMPANY
Established 1914
Manufacturers of Self-Sticking Tape Products
804 N. 3rd Street, Milwaukee 3, Wisconsin
Factory—Chippewa Falls, Wisconsin

up contact method. Extensometer will operate to rupture. Specimen is heated by a small furnace (see left-hand photo) with Chromel wire coils in three banks to provide temperature adjustment in top, middle and bottom zones by means of rheostats. Standard maximum temperature 1600°F.; 1800 and 2200°F. furnaces can be supplied. Maximum possible elongation of the specimen is 1¾". — *Baldwin Locomotive Works, Philadelphia 42, Penna.*

Please mention number 620 when filling out card

Stand-off Terminals and Connectors

New complete line of small stand-off terminals provide a rugged, well insulated tie-point, or mounting block, in

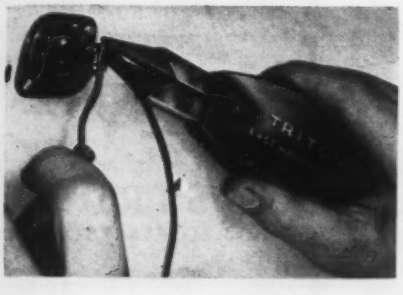


a minimum of space. Molded-in terminals, machined of brass, are silver-plated for rapid, easy soldering. New "High Voltage Control Stand-Off No. 401" (left) fits all standard variable resistors, affords ample insulation to prevent voltage breakdown, eliminates shock hazard, mounts on panels drilled in accordance with RMA standard for variable resistors. Spacing between high voltage and grounded metal parts is 1 3/16". A lock arm prevents rotation of the control with respect to the panel. New 4-contact miniature connectors (right) have been designed for applications where space is extremely limited. One-piece inserts are molded of Melamine. Silver-plated phosphor-bronze sockets insure good contact action.—*The Winchester Co., 6 East 46th St., New York 17, N. Y.*

Please mention number 621 when filling out card

Instrument Soldering Tool

New "Pres-to-Heat" soldering tool operates from a.c., uses a 6-volt transformer and a light-weight heating unit. A spring-actuated lever, when compressed, closes two plier-like carbon electrodes on parts to be soldered. Further compression switches current on for period required to melt solder. Slightly releasing lever turns off current and permits work to be held be-

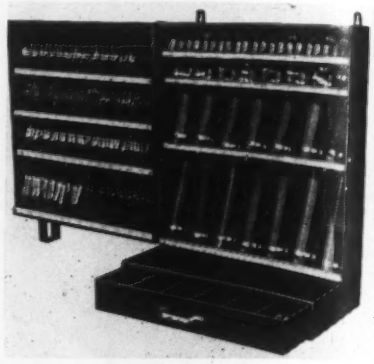


tween jaws until solder has cooled. Current is consumed only when the soldering operation is being performed. —*Triton Mfg. Co., East Haddam, Conn.*

Please mention number 622 when filling out card

Resistor Kit

New "Basic Kit" of most-used resistor types and ranges is especially suited for engineering and development

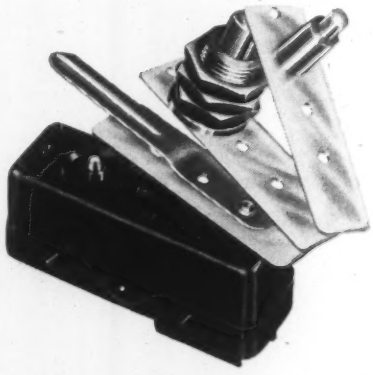


labs, broadcast stations, schools and colleges. Kit consists of 471 "basic" resistors, plus 6 additional bands for adjustable types. No extra charge for cabinet. Resistor assortments are in most cases so arranged that a lack of stock in one range may be compensated for by using two other ranges in series or parallel.—*International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.*

Please mention number 623 when filling out card

Interchangeable Auxiliary Actuators for Snap Switches

New removable and interchangeable actuators for "Unimax" snap-action switch allow basic switch to be adapted

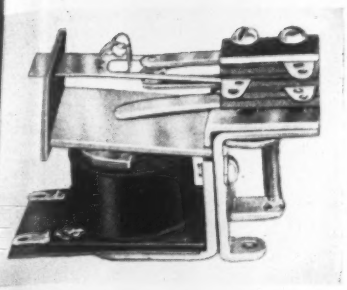


to varied uses with auxiliaries added in factory assembly or to be stocked separately. Actuators are mounted on stainless steel plates, so that a uniform relationship is established between actuators and switch-operating button by fixed dimensions in mounting plate and phenolic housing.—*Unimax Switch Corp. Subs. of W. L. Maxson Corp., 460 West 34th St., New York 1, N. Y.*

Please mention number 624 when filling out card

Snap Switches for Relays

New complete line of snap-action switches is available in conjunction with maker's standard relays. Snap-

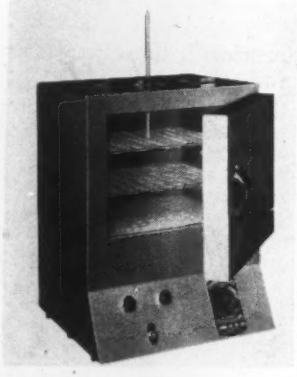


tion feature is particularly suited to ntrol applications that involve slow-oving mechanical devices or where a ven stroke is required to provide ick, positive "make" or "break" con-ct action. It is claimed that chatter-g, arcing, intermittent contact pres-re and other circuit operating prob-ms are eliminated. Illustrated is Series 100 Relay" with a snap-action vitch for motor starting circuits (cir-it diagrams available). A snap-ac-on switch relay can be used in place a centrifugal switch normally (and conveniently) installed in motor hous-g. — *Guardian Electric Mfg. Co., ept SA, 1638 West Walnut St., Chi-ago 12, Illinois.*

Please mention number 625 when filling out card

Laboratory Oven

New "KH 1200" electric laboratory n features equalized heat by means a double-venting device. Automatic



ydraulic-electric temperature control feature has accuracy of ± 1°C. at any desired point within furnace range to 220°C. Internal dimensions 12" × 10" × 10"; outside 15⅜" × 21¼" × 15".— *The K. H. Huppert Co., 6830 Cottage Grove Ave., Chicago, Illinois.*

Please mention number 626 when filling out card

Electric Soldering Iron

New "No. 300 Hatchet Type" electric soldering iron enables operator to solder in a more natural position, mini-

Bulletin of the Month

"BRIDGE-MEG" INSULATION and RESISTANCE TESTER

*REG. U. S. PAT. OFF.

DESIGNED and built to provide maintenance men with practically everything necessary for electrical resistance measurements from a fraction of an ohm up to 1000 megohms, the "Bridge-Meg" type of "Megger"* instrument combines in one compact, *portable* unit the facilities of a "Megger" Insulation Tester and a Wheatstone Bridge.

You'll find the "how and why" of the "Bridge-Meg" Insulation and Resistance Tester described fully within the profusely illustrated pages of this Bulletin of the Month. *Your* copy is waiting. No obligation, of course. Send *today* for Bulletin 21-60—IJ.

James G. **BIDDLE CO.**

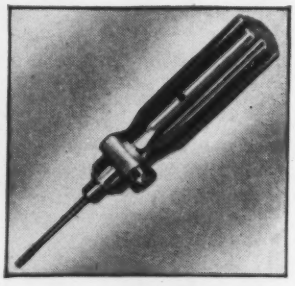
ELECTRICAL & SCIENTIFIC INSTRUMENTS

1316 ARCH STREET • PHILADELPHIA 7, PENNA.

New Type of Torque Tools Incorporate Spring Clutch! . . . Are 98% Accurate!

Acme Torque Wrench and Screw Driver both incorporate spring clutches, with easily operated control. After setting control to desired torque, the operator merely turns tool in the usual way. When the torque required to drive the threaded part exceeds the pre-set value, the tool slips. Impact doesn't cause driving torque to increase. Oil doesn't affect setting which is reproducible within 2% or better.

The Wrench offers right and left-hand drive, ratchet action and withdrawal. Spring clutch may be set from 0 to 500 inch pounds. Standard sockets are interchangeable. The Screw Driver may be set for any value of torque from 0 to 35 inch pounds. A ratchet action is incorporated. The same tool will also withdraw screws. Standard bits, including socket types, may be easily inserted. The tool is made of pressure cast aluminum.



Torque Screw Driver

Another Time-Saver on the job, is chewing gum. The act of chewing aids the workers' concentration—seems to make the work go easier. Chewing gum may be used even when workers' hands are busy; reducing interruptions from the job. For these reasons many plant owners have made Wrigley's Spearmint Gum available to everyone.

You can get complete information from Acme Scientific Company, 1450 W. Randolph St., Chicago 7, Ill.

AB-64

mizing fatigue. Inaccessible spots can be reached without stooping or bending over the work. Heating element is housed in a damage-proof hexagonal shaped barrel that permits clamping in a vise for easy tip removal without danger of injuring heating element. Tips are hard drawn copper; simple to remove. Each iron is furnished with a stand.—*Hexacon Electric Co., 179 West Clay Avenue, Roselle Park, N. J.*

Please mention number 627 when filling out card

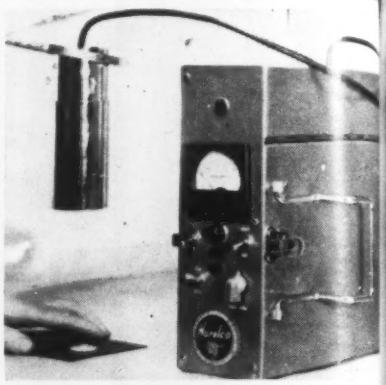
Rapid-indicating Multi-point Potentiometer

New "Speedomax Indicator" is a rapidly-self-balancing potentiometer for applications where a large number of thermocouple temperatures must be logged in a short time. To read a temperature, operator merely flips a key switch marked for desired thermocouple; instrument's drum scale spins and then stops at the correct temperature. When logging temperatures, limiting factor is speed with which operator can write down his readings. Instrument being a true potentiometer, it has high sensitivity and accuracy, even for low temperatures and short ranges. Wide markings make scale easy to read. Switching arrangements can be supplied to meet needs of practically any application. A single instrument easily handles more than 100 thermocouples. Key switches can be color-coded for convenience in identifying points.—*Leeds & Northrup Co., 4934 Stenton Avenue, Philadelphia 44, Penna.*

Please mention number 628 when filling out card

Geiger-tube Radiation D tecto

New portable Geiger-count ra tion detector is battery powere is c ried by hand or by means of a houl

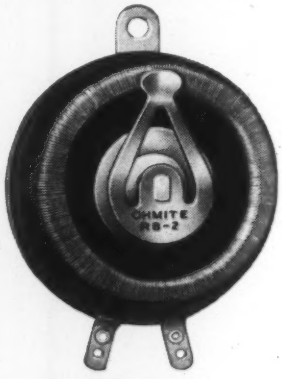


strap. Geiger tube housing permits d ferential detection of hard and s components. Controls and indicators a located on top panel so that adju ments and measurements can be ma while unit is being carried. Indicat shows rate at which pulses are receiv and also is used to determine potent applied to Geiger tube. Visual indic tion of pulse rate is provided by flash mounted on panel. Audible signals c be received by head phones. High- a low-voltage supplies switch is inte locked with cover. Metal cabinet mea ures 12¼" × 11¾" × 4¼"; instrume complete with batteries weighs 17 lbs.- *North American Philips Co., Inc., East 42nd Street, New York 17, N.*

Please mention number 629 when filling out card

Direction-indicating Resistor

New "Model RB-2 Direction-Indicat Potentiometer" is said to provide simple method of indicating the positi



of a rotary-beam antenna, wind van or other rotating device. Its shaft is coupled to antenna and it is connected by means of a simple circuit, to a 6-volt battery and a milliammeter (with specially marked scale) which will indicate position of antenna. Maximum current drain is a few milliamperes.—*Ohmite Mfg. Co., 4855 Flournoy St., Chicago 44, Illinois.*

Please mention number 630 when filling out card

Test Oscillator

New "Type WR-67A Test Oscillator is a portable test unit designed with special features to aid servicemen in rapid aligning and trouble shooting of

radio and broadcast equipment. It operates from 100 kc. to 30 Mc.—*Test and Measuring Equipment Sec., RCA Victor Div., Camden, N. J.*

Please mention number 631 when filling out card

Sweep Generator

New "Type WR-53A Sweep Generator" is designed for FM receiver alignment. It is used in the alignment of i-f. transformers in the 9.5 to 11.5 Mc. range; is also used to align the r-f. stages of FM circuits in the 88 to 108 Mc. range.—*Test and Measuring Equipment Sec., RCA Victor Div., Camden, N. J.*

Please mention number 632 when filling out card

Cabinet for Multipoint Gas Alarm

New "Multipoint Alarm Cabinet" for detection of combustible gas concentration occupies 2 2/3 ft.^{2} of floor area. It is available for sampling from a minimum of 6 locations to a maximum of 12 locations. Cabinet is composed of a series of panels as illustrated. On top panel are mounted indicator, motor, main switch, alarm relays and push button controls; other 7 panels are connected to individual analyzing heads; in base is mounted a sampling pump which continuously draws samples through all analyzing heads. Each analyzer panel is consecutively connected with top panel for ten seconds. Thus, if six areas are being sampled, a complete tour can be made in one minute. During connection a white pilot light flashes on analyzer panel to show that gas percent in the area being tested can be read on indicator. When concentration reaches alarm point setting, a red pilot light flashes on corresponding panel; and an audible signal sounds both in cabinet and in area. Provision has been made for stopping timer to hold a panel for further observation. On top panel are mounted push button controls for silencing audible signals and extinguishing red alarm lights on individual analyzing panels. New system may be connected to relays which will actuate CO_2 or fog fire blanketing systems.—*Davis Emergency Equipment Co. Inc., 80 Halleck St., Newark 4, N. J.*

Please mention number 633 when filling out card

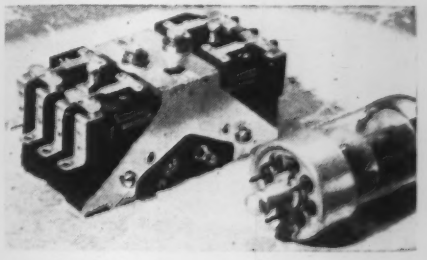
Dry Electrolytic Capacitors

New "Type LB" miniature dry electrolytic capacitors embody "new method of producing unprecedentedly high-gain and stable etched foil." Availability of new units is said to free circuit designers from space limitations. Capacitance values available for low ripple service in a ⅜" × 1⅛" container range from 8 mf. at 150 wvdc. to 200 mf. at 1.5 wvdc.; in a ⅜" × 1⅝" tube maximum capacitances range from 12 mf. at 150 wvdc. to 300 mf. at 1.5 wvdc. Maximum a-c. ripple voltage which may be applied to capacitors rated at 100 wvdc. and greater is 7 volts at 60 cycles or 3.5 volts at 120 cycles.—*Solar Mfg. Corp., 285 Madison Avenue, New York 17, N. Y.*

Please mention number 634 when filling out card

Latching Relays

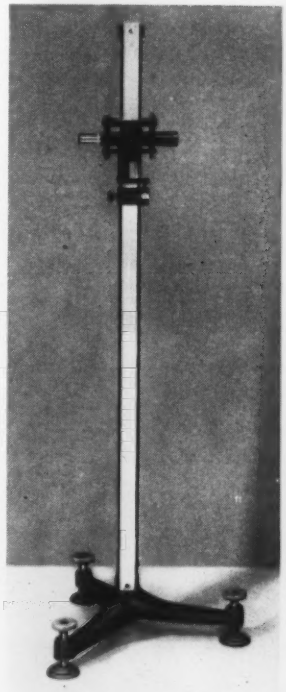
New "Type 6FZ" multi-circuit switching relays of latching type have entire moving system dynamically balanced, while operating with detent forces of over 200 inch-grams, achieving exceptional freedom from effects of vibration and shock. Mechanical wear does not lessen, but, if anything, increases latching stability, resulting in a mechanical life well up into millions of operations, it is said. Each of eight individual switch positions may be normally open or normally closed, nominal rating 5 amperes at 110 volts a.c. or 24 volts d.c. Contacts may be ganged or arranged in pairs for a maximum of 4 double-break circuits as illustrated. Coils operate from d.c. (or rectified a.c. supplied from a single midget sele-



Gaertner

M907-M908

CATHETOMETERS



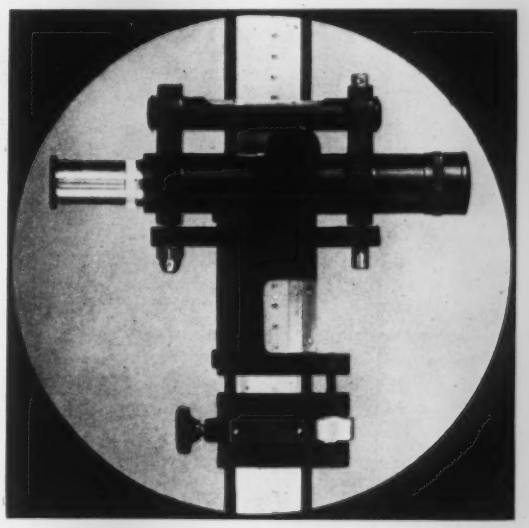
For vertical measurements on objects located near sources of dangerous radiation, within controlled atmosphere enclosures, or otherwise inaccessible.

Range of Measurement

M907 ..... **60 cm**

M908 ..... **100 cm**

The carriage slides on an accurately straight guide rod and is provided with delicate height adjustment. The scale may be read by vernier to 0.05 mm. Working distance is from 60 cm to infinity.



Complete details on these and more than a dozen other types and sizes of cathetometers will be found in Catalog M138.

THE GAERTNER SCIENTIFIC CORP.

1211 WRIGHTWOOD AVE. · CHICAGO 14 · U.S.A.

Speedy • Accurate

RESISTANCE MEASUREMENTS

. . . with the Rubicon
PORTABLE WHEATSTONE BRIDGE

This convenient instrument combines instant portability with high accuracy and is widely used in laboratory, plant and field. Built for dependable service under hard usage.

- Wide range: 1 ohm to 10 megohms
- Limit of error: 0.1%
- Built-in battery and galvanometer
- Provision for external battery and galvanometer when required
- Available with Murray and Varley loop circuits
- Compact and rugged

. . . with the Rubicon
PORTABLE KELVIN BRIDGE

For work at very low resistance levels this instrument is the counterpart of the Wheatstone bridge shown above.

- Range: 0.0001 to 10.1 ohms
- Limit of error: 0.25%
- Built-in battery and high sensitivity "Pointerlite" galvanometer
- Provision for external battery and galvanometer when required
- Sturdy and convenient in operation

Wheatstone and Kelvin bridges in a variety of models, together with other resistance measuring instruments, are fully described in Bulletin 100 available on request.

SPOTLIGHT GALVANOMETER

- Sturdy, short period
- Sensitive (up to 0.0006 μA per mm.)
- Multiple-reflection optical system
- For null or deflection measurements

Described in Bulletin 320

OTHER RUBICON INSTRUMENTS

Resistance Standards • Mueller Bridges • Precision Potentiometers • Evelyn Photoelectric Colorimeter for chemical analysis • Automatic Recording Photometric Analyzers for NO and H_2S • Magnetic Permeameters • Magnetic Hardness Testers • Shorted-Turn Coil Testers • Other equipment involving precise measurement of electrical quantities.

RUBICON COMPANY
Electrical Instrument Makers
3755 Ridge Ave. • Philadelphia 32, Pa.

nium rectifier stack or any circuit), require pulses of less watt for tripping, and are with resistances from low v 10000 ohms. For some types o ory" applications a high-sensiti justment is provided and power ments are as low as a few m (relay tripped by a 50-volt cha ¼-mfd capacitor). Applications momentary-contact controls, protective circuits, etc.—*Sigma ments, 70 Ceylon St., Boston, M*

Please mention number 635 when filling

Oscilloscope for Hydraulic-system Analysis

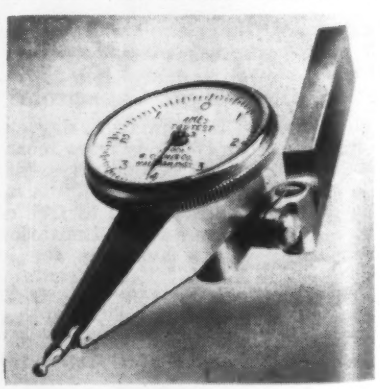
New "Hydrauliscope" was develope especially for checking pressure surges etc., occurring in hydraulic systems. I

comprises a pressure pick-up (various ranges available), a specially-designed amplifier, a specially-designed cathode-ray oscilloscope with flat frequency response from 0 to 20,000 cps., etc. Apparatus is said to give consistent results when used by persons unfamiliar with electronic devices. — *Aeroquip Corp., Jackson, Mich.*

Please mention number 636 when filling out card

Dial Indicator

New "Trutest" universal dial indicator features automatic reversible action that eliminates the tripping of a latch in changing from "over" to "under" work. Another feature has indicator hand always moving clockwise, whether top or bottom of contact point is in use. Dial is 1 3/16" diameter. Two



contacts are furnished: 0.100″ dia. and 0.031″ dia. Also two support bars: ¼″ wide for tool post work, and ⅛″ wide for height gage work. New "Trutest" is available in two models, No. 1 reading in 0.0005″, with 0-15-0 dial; No. 2 reading in 0.0001″, with 0-4-0 dial. Contacts are all interchangeable in both models. —*B. C. Ames Co., Waltham 54, Mass.*

Please mention number 637 when filling out card

Reversible Plug Gages

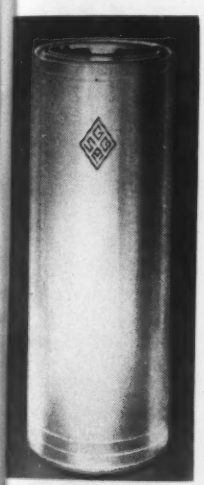
New reversible plug gages are made of Norbide, said to be "almost unwearable" and to give new gages "200

times the service life of old style taper lock steel gages." Plugs reverse quickly in positive-locking, pin-vise handle. Aluminum handle minimizes weight. "Go" end is finished in green: "No-Go" in red.—*Size Control Co., 2500 Washington Blvd., Chicago 12, Ill.*

Please mention number 638 when filling out card

Stainless Steel Vacuum Flasks

New stainless-steel Dewar flasks feature new principles of construction; contain a new type of radiation shield (pat. appl. for). They are said to be unbreakable and explosion-proof; also if punctured or otherwise damaged, easily repairable. Any gases which might cling to the metal surfaces are absorbed by activated charcoal contained in a section of the evacuated space. Seams are interlocked for greater strength. Six sizes are available, ranging in capacity from 400 ml. to 50 liters. Intermediate capacities are obtainable by variations in depth. Largest size (13″ I.D. × 24″ inside depth) is furnished with an extra outer casing equipped with carrying handles. Special units can be made to order.—*Scientific Glass Apparatus Co., Bloomfield, N. J.*



Please mention number 639 when filling out card

Diaphragm Motor

New "Series 600 Diaphragm Air Motor" is designed primarily for use with maker's "Adjustable Port Valves" but can be used to operate various types of valves, dampers, rheostats, etc. It is designed for 0-15 lb./in.^{2} control-instrument air pressure and the 10-lb. range of 3 to 13 lbs./in.^{2} results in full travel of motor arm (26°) and develops 25

Enjoy "next door" convenience with all your suppliers

It doesn't matter where the supplies and replacement parts you need are located. They can be delivered to you in hours when you specify Air Express. Air Express gives you same-day delivery between many towns and cities. Even overnight coast-to-coast shipments are now routine.

Air Express is a better value than ever at today's low rates. Planes are bigger and faster and schedules more frequent. So, serve your customers better, and keep profits high, too! Use the speed of Air Express regularly.

Specify Air Express-it's Good Business

- Low rates include special pick-up and delivery in principal U.S. towns and cities. • Moves on all flights of all Scheduled Airlines.
- Air-rail between 22,000 off-airline offices.
- Direct air service to and from scores of foreign countries.

Just phone your local Air Express Division, Railway Express Agency, for fast shipping action. . . . Write today for Schedule of Domestic and International Rates. Address Air Express, 230 Park Avenue, New York 17. Or ask for it at any Airline or Railway Express Office. Air Express Division, Railway Express Agency, representing the Airlines of the United States.

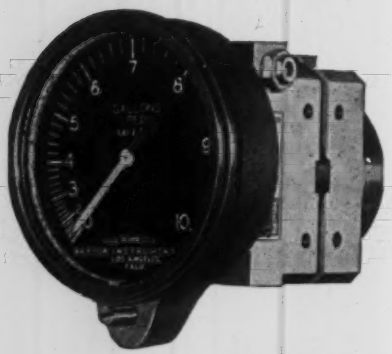
AIR EXPRESS

GETS THERE FIRST

Rates are low

For example: to Air Express a 22-lb. shipment **1100** miles costs only **$7.43.** 10-lbs. for **$3.58.** Other weights—any distance — similarly inexpensive.

Differential Pressure
INDICATOR



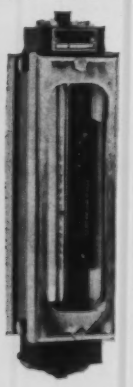
FOR RATE OF FLOW AND LIQUID LEVEL MEASUREMENTS
Suitable for Static Pressures Up to 3,000 P.S.I.

HAS RUPTURE-PROOF BELLOWS UNIT
An exclusive feature. Sensitive and accurate under high operating pressures. Withstands extreme over-ranging.

Write for descriptive bulletin No. 11C3.

BARTON INSTRUMENT CO.
3500 UNION PACIFIC AVE.
LOS ANGELES 23, CALIFORNIA

The Full-View
ROTAMETER



gives research flexibility!

The Full-View Rotameter provides extraordinary help to the research or pilot plant worker for flow rate measurement. Four pyrex metering tubes of different capacities will fit into one rotameter case. Also each tube has four floats that have individual ranges. Thus with one frame, four tubes and sixteen floats, a liquid range of 0.2 c.c. to 200 c.c. per minute and a gas range of 10 c.c. to 7000 c.c. per minute may be obtained.

With brass or steel end fittings, the price of all this equipment is only $101.00. With type 304 stainless steel fittings, the price is $130.00. Delivery from stock. A set-up like this one on hand will give you the equipment to measure *immediately* any flow rate requirement that may come up in your research. For full information, write Brooks Rotameter Company, Box A-2647, Lansdale, Pa.

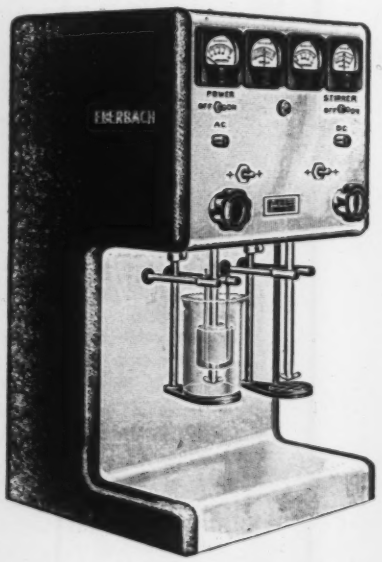
BROOKS ROTAMETER CO.
LANSDALE, PA.

lb.-in. torque for 1 lb. change in controller pressure. (These ratings are for "No. 600-65" size.) Provisions have been made for a valve positioner to maximize valve-response accuracy. Mounting lugs are provided for fastening to supports independent of piping and motor can be mounted in any position relative to piping. Deliveries can be made from stock.—*The North American Mfg. Co., 4455 E. 71st St., Cleveland 5, Ohio.*

Please mention number 640 when filling out card

Electro-analysis Apparatus

New model of Electro-analysis Apparatus is built for constant service, is adaptable also for research work. Built-

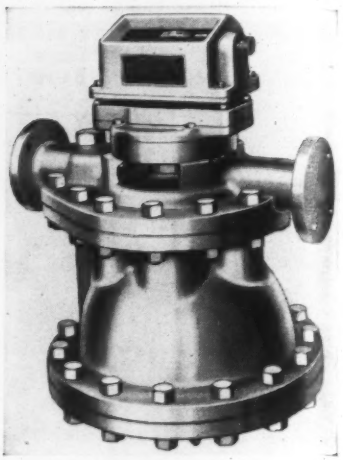


in selenium full-wave rectifier delivers 8 volts 5 amperes d.c. at both spindles for simultaneous determinations or 10 amperes d.c. for a single determination. Stirrers rotate at constant speed of 550 r.p.m., are adjustable for height. All electrodes including rotating type may be used. When using rotating anode set-up, no circuit changes are required. Instruments and mechanism are enclosed to protect them from acid fumes. Several units may be "banked" side by side for bench or wall mounting. Auxiliary heaters are available. Apparatus may be used on either 110- or 220-volt 60-cycle single-phase a.c. Power requirement 400 watts maximum. He... all 29½", table space 14½" ... 16½" deep.—*Eberbach & Son ... Arbor, Mich.*

Please mention number 641 when filling ...

Liquid Meter

New 1½" 50-g.p.m. positive-... ment meter is for applications ... ing stainless steel equipment to ...

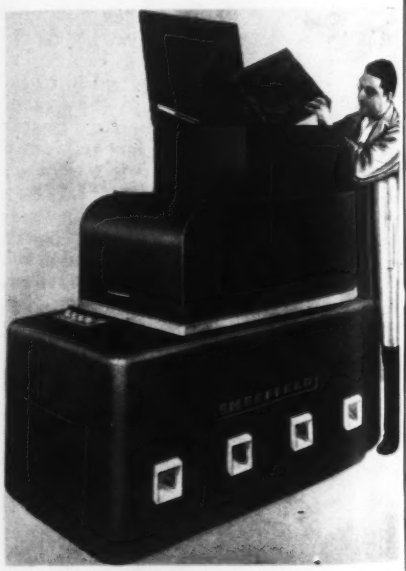


corrosion, discoloration or contamination. In design and principle of operation it is basically similar to maker's "Industrial Xacto" meter but is constructed of stainless steel. Maximum working pressure 250 lbs./in.².—*Bowser, Inc., Fort Wayne 2, Indiana.*

Please mention number 642 when filling out card

Automatic Gage and Sorter for Rolls, etc.

New automatic hopper-fed roll selector for 100% inspection of length and diameter of small precision parts such



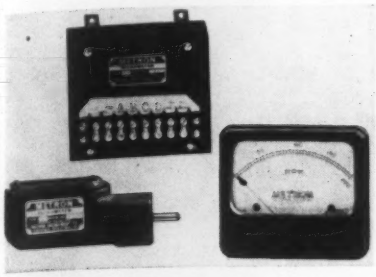
as roller bearings, dowel pins, chain links, etc., gages to a tolerance of 0.0005", segregates rolls into four classifications at rate of 3600 per hour. Range of adjustment, 7/32" to 31/32" on diameters and 9/32" to 3" on lengths. After setting up (using minimum and maximum masters or two parts known

to be correct size) the rolls are placed in a hopper. All parts that contact the rolls are made of materials that prevent magnetic congestion of rolls.—*The Sheffield Corp., Dayton 1, Ohio.*

Please mention number 643 when filling out card

Electric Tachometers

New "Type 42" electric tachometer indicators are especially designed to be built into equipment, can be used with

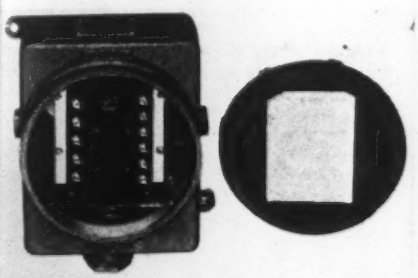


any of "Metron Tachometer Heads" for speeds from 1 to 100,000 rpm. More than 50 standard speed ranges are available and dial can be calibrated in any units such as knots, fpm., rpm., impressions per hour, etc. Operating power is obtained from 110-volt 60-cycle a.c. or whatever d-c. voltage is available. Accuracy is 1%.—*Metron Instrument Co., 432 Lincoln St., Denver 9, Colo.*

Please mention number 644 when filling out card

Liquid-level Controller

New "Type 10CB1X Level Control" has been designed with particular consideration to problems of chemical proc-



essing field. No vacuum tubes are used. Accuracy is independent of temperature and pressure. An a-c. probe circuit and transformer are combined to operate a d-c. relay. Two stainless-steel probe rods project into tank at levels corresponding to low point where pumping is to start, and high point at which pumping stops. "Type 10CB1X" is supplied as illustrated in an explosion-proof housing, or in a pressed-steel dust-tight enclosure; operates on 115/230-volts, 25/60-cycles a.c. A selection of four terminals on the terminal panel enables probe circuit to be matched to electrical conductivity of the liquid to be controlled. — *Photoswitch Inc., 77 Broadway, Cambridge 42, Mass.*

Please mention number 645 when filling out card

Electrical Prospecting Apparatus

New "Self-potential Apparatus" is a complete outfit for conducting prospecting and scientific investigations by the spontaneous polarization method. Principle: certain ore bodies and formations

LABORATORY
HYGROMETER
(RELATIVE HUMIDITY)

SIZE-4½" x 4" x 3", weight-11 oz.
Price $35

Type HGS–HY–1

The Leader in an Elusive Field... Humidity Measurement

SERDEX INC.

ACCURACY — within ± 2% Relative Humidity at temperatures from — 35° F. to + 130° F. and from 15% RH to 100% RH.

SENSITIVITY heretofore unattained, response almost instantaneous.

REPEATABILITY — day in and day out — requires no conditioning — no piping — no wiring.

DIRECT DIAL READINGS — no correction charts — no calculations — services of trained technician not required.

Industrial Humidity Controls
Hygrometers
Microhygrographs
Hygrothermographs
Telemetering
Chronometric Radiosondes
Ship Stability Indicators
Electronic Centisecond Timers
Coaxial Antennae
Specialized Radio Communication

Catalogue upon request

SERDEX INC. 91 Cambridge St. Boston 14, Mass.

• RUGGED
• DEPENDABLE
• ACCURATE

Burlington

PANEL INSTRUMENTS

For utmost reliability—specify and depend upon Burlington Panel Instruments. They are designed, engineered and built to give satisfactory service even under most severe applications—and are fully guaranteed for one year against defects in material or workmanship.

Write today for full details.

BURLINGTON INSTRUMENT COMPANY
223 FOURTH STREET BURLINGTON, IOWA

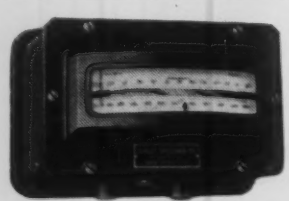
AMTHOR
TENSILE STRENGTH
TESTERS
for
PAPER
CORDAGE
RUBBER
LEATHER
WIRE
FLAT MATERIALS

PAPER FOLDING ENDURANCE TESTER
BURSTING TESTER
MICROMETERS (POCKET and DESK)
PAPER BASIS WEIGHT SCALES
CORDAGE SCALES
ALUMINUM FOIL SCALES
COMPUTING SCALES
RUBBER ABRASION TESTER
DEAD WEIGHT PRESSURE GAUGE TESTER
TACHOMETERS INDICATING and RECORDING
MERCURY COLUMN GAUGES

AMTHOR
TESTING INSTRUMENT CO. INC.
48 Van Sinderen Ave., Brooklyn, N. Y.

Wall-Type
INDICATOR PYROMETER

A PRODUCT OF 40 YEARS OF RESEARCH

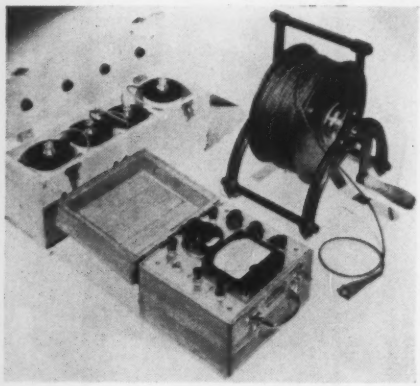


Model W-1
Switchboard Indicator

Unskilled help may handle this direct-deflection instrument, which needs no manual adjustment. Designed for numerous ranges of temperature, both F. and C.

Write for descriptive Bulletin 400

Charles Engelhard, Inc.
233 N.J.R.R. Ave. Newark 5, N. J.

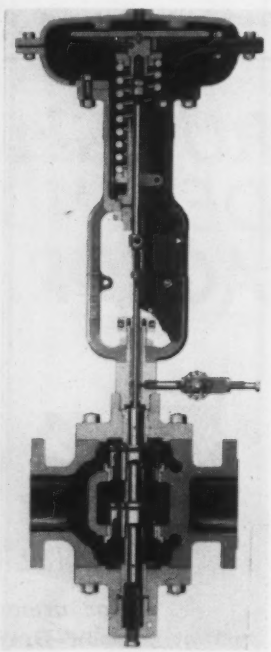


act as a sort of "battery." (Pyrites and graphite are two examples.) By making surface measurements at regularly-spaced stations, it is possible to determine location of such ore bodies. Apparatus consists of a light-weight sturdy field potentiometer, a set of four non-polarizing electrodes with a special carrying case, copper sulphate crystals required for non-polarizing electrodes, aluminum alloy reel with 1000 feet of high-strength light-weight field cable, etc.—*Geophysical Instrument Co., Arlington, Va.*

Please mention number 646 when filling out card

Diaphragm-motor Valves

New "Series 700" diaphragm-motor valves have anti-friction design and construction features, among them non-

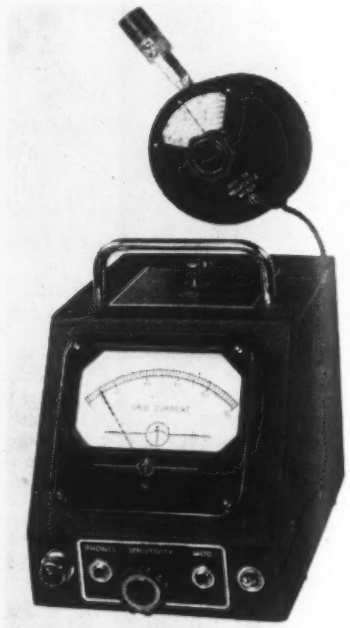


buckling Neoprene diaphragm; ball pivot transmitting diaphragm force to stem; cradle mounting of upper spring flange preventing side thrust; "reinforced" parallel ground and squared spring ends; non-rising spring adjustment permitting use of widely different air-pressure ranges; duplex lubricated stem guide bearings, etc. Exclusive "Equipoise" valve body with diverted inlet balances velocity effect on disk and minimizes wear ("Direct Inlet" design optional for deposit-forming chemicals, etc.). Seven styles of inner valves make available all characteri[illegible]cs th[illegible] may be required by automat[illegible]-contr[illegible] engineers.—*H. Belfield Co., [illegible]oad S[illegible] at Hamilton, Philadelphia 23, [illegible]enna.*

Please mention number 647 when filling [illegible]

Variable-frequency Oscillator-wavemeter-detector

New "Model 59 Megacycle M[illegible]ter" a variable-frequency oscillator, an a[illegible] sorption wavemeter, an oscilla[illegible]ng d[illegible]

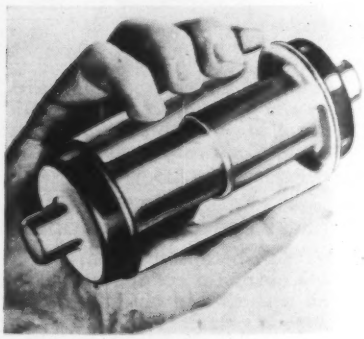


tector and a tuned absorption circu[illegible] detector. Among uses: measuring ca[illegible] pacitance, inductance, Q, resonant fre[illegible] quency, etc., generating signals, etc. Frequency range, 2.2 Mc. to 400 Mc.; modulation, CW or 120-cycle fixed at approx. 30% at 15 Mc., or external. Power unit is 5⅛" × 6⅛" × 7½", weighs 6½ lbs.; oscillator unit is 3¾" diam. × 4", weighs approx. 1 lb.—*Measurements Corp., Boonton, N. J.*

Please mention number 648 when filling out card

Vacuum Capacitors

New series of vacuum capacitors is announced. Designations connote electrical characteristics. Thus in "CAE 50/-60/-30" (illustrated) first numeral designates capacitance in mmfd tolerance ±2%; second numeral safe current capacity in amperes; last figure peak potential in kilovolts. Capacitor is of low-loss construction, suitable for

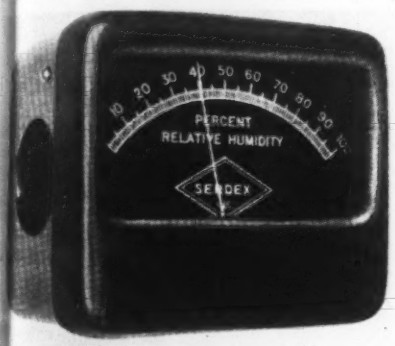


high-frequency applications. Features are use of large elements; large-periphery glass-to-copper seals resulting in low temperature coefficient; end caps gold-plated to maintain low contact resistance. Over-all dimensions $2\frac{1}{2}$" × $6\frac{1}{2}$". — *United Electronics Co., 42 Spring St., Newark 2, N. J.*

Please mention number 649 when filling out card

Indicating Hygrometer

New "Model HGS-HY-1" laboratory hygrometer utilizes newly-developed "Serdex Humidity Sensitive Element"



said to be capable of a high degree of repeatability and extremely low lag (3.25 seconds). Instrument accuracy, ± 2% RH at ambient temperatures as high as 135°F. Weight, 11 oz. Size, 4" × $4\frac{1}{2}$" × 3".—*Serdex, Inc., 91 Cambridge St., Boston 14, Mass.*

Please mention number 650 when filling out card

Surveying Odometer

New one-man odometer is of dustproof construction, weighs $8\frac{1}{2}$ lbs., has a 9999-ft. quick-reset cyclometer reg-

ister. Clutch is of positive type: pull trigger to engage, press button to release.—*Matthews Instrument Co., 1129 Boylston St., Newton Upper Falls 64, Mass.*

Please mention number 651 when filling out card

Transparent-case Electrical Instruments

New $3\frac{3}{4}$" panel instruments have unbreakable-front "Crystal Clear Plastic" case which gives more usable scale

You're FACE TO FACE WITH ALL THE FACTS

At a glance, the face of this CORBIN Tachometer will tell you the number of TONS PER HOUR, TONS IN BATCH and TOTAL TONS up to that time. Whether you're counting tons or cases, bottles, bales . . . or measuring in lengths, or counting revolutions . . . Corbin can engineer a Corbin Tachometer to meet your requirements.

You can depend on a CORBIN Tachometer to give you the facts *face to face* . . . to respond instantly, operate smoothly without lubrication, and last for years — and years.

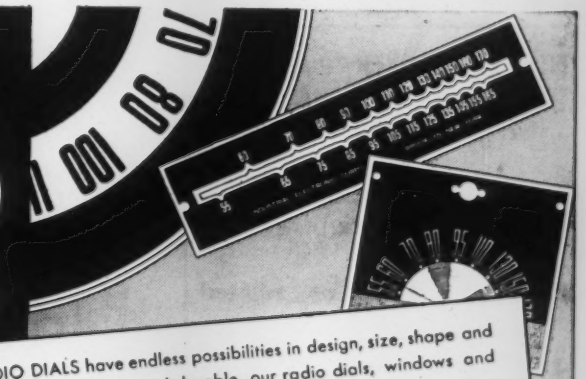
No guesswork when you use a CORBIN Tachometer.

Corbin Screw Division
American Hardware Corp.
New Britain, Connecticut

PA-3

Accurate CORBIN Tachometers

HOPP
Plastic
RADIO
DIALS



DIAL WINDOWS • NAME PLATES • SCALES • GAUGES • CHARTS • CALCULATORS ETC.

PLASTIC RADIO DIALS have endless possibilities in design, size, shape and color combination. Attractive and durable, our radio dials, windows and scales are preferred by many leading Radio manufacturers.

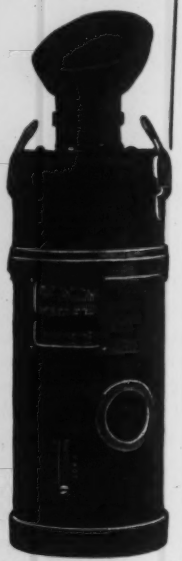
Not only for dials, but for numerous other electronic and electrical applications, Laminated Plastics are preferable.

Consult with our artists and engineers regarding applications for your particular purpose. Or . . send blueprints or samples for quotation.

THE HOPP PRESS, INC.
ESTABLISHED 1893
460 WEST 34th STREET, NEW YORK 1, N. Y.

PYRO THE SIMPLIFIED OPTICAL PYROMETER

SAVE TIME AND MONEY!



By using PYRO, a self-contained, DIRECT READING, sturdy unit made to stand rough use. It is absolutely accurate and dependable, and quickly pays for itself.

Unique construction enables operator to rapidly determine temperature even on minute spots, fast moving objects, or smallest stream; no correction charts, no accessories, no maintenance expense. Special "FOUNDRY TYPE" and "Universal TRIPLE RANGE" have, in addition to standard calibrated range, a red correction scale determining TRUE SPOUT and POURING TEMPERATURES of molten iron and steel when measured in the open.

Stock ranges 1400° F. to 5000° F.

Bulletins on PYRO Optical, Radiation, Surface and Immersion Pyrometers on request.

THE PYROMETER INSTRUMENT CO.
Plant & Lab
103-107 LAFAYETTE ST., NEW YORK, N. Y.
In Canada, Sales and Repair Laboratory:
Dominion Flow Meter Company Limited
Toronto and Montreal

High precision OPTICAL PARTS for Research, Development or Production.

•

PARABOLIC or SPHERICAL Mirrors.

•

LENSES, PRISMS or related components for your visual, photographic or electronic requirements.

•

Natural or Synthetic CRYSTAL OPTICS.

•

Complete optical INSTRUMENTS.

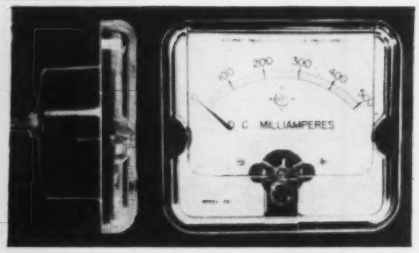
•

Vacuum Coating of Optical Parts.

•

John Unertl Optical Co.

3551-3555 East Street
Pittsburgh 14, Penna.

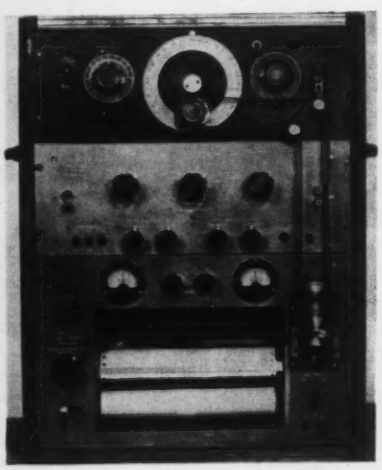


space and permits more light to reach dial for easier reading. Dial can be finished in colors to harmonize with equipment on which new instruments are used. Instrument is readily illuminated from front or rear: light on back of case will "pipe" through plastic to cast soft illumination on dial. Shock-resistant movement has polished pivot bearings and vee jewels. Available types: moving-coil, repulsion-iron-vane, rectifier, thermocouple high-frequency, and pyrometer; all popular ranges of volts, millivolts, milliamperes and amperes, both a.c. and d.c. For ultra-sensitive microammeters, specially-designed Alnico 11 magnets are used. Instrument measures 3¾" wide by 3⅜" high and projects less than ⅝" in front of panel.—*Assembly Products, Inc., Chagrin Falls, Ohio.*

Please mention number 652 when filling out card

Impedance Analyzer

New "Impedance Vectograph" makes possible direct graphical recording of resistive and reactive components of an

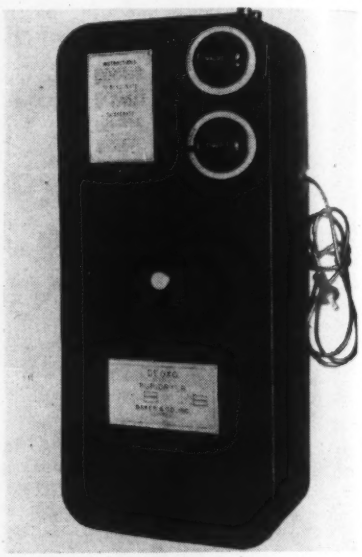


impedance as a function of frequency, when used in conjunction with maker's "Twin Recorder" and a beat-frequency oscillator. Resistance and reactance can be separately, and simultaneously, measured and recorded from 1 to 4000 ohms in 6 ranges with separate expansion of either scale of ½, ⅕, or 1/10 of the other scale. A reactance polarity check is provided to show on record whether reactance is positive or negative. New instrument is useful for measurements on transducers, filters and transmission lines.—*Sound Apparatus Co., 233 Broadway, New York 7, N. Y.*

Please mention number 653 when filling out card

Gas Dryer-purifier

New "Deoxo Puridryer" is an automatic instrument which removes oxygen impurities and eliminates moisture from gases. Installed on low-pressure line, it purifies hydrogen, for example, so that less than 1 ppm. of oxygen impurities remains, and then dries the gas to dew points of better than —90°F. It may also be used with such gases as nitrogen, argon, neon and saturated hydrocarbons. Capacity depends upon moisture content and impurity of incoming gas. Using bottle hydrogen of 99.7% purity and a maximum flow of 50 cfh., pure gas with dew points better than —50°F. for over 36 hours of

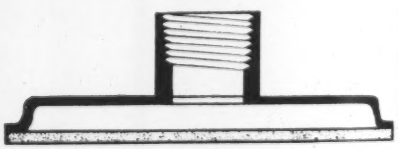


continuous operation is attained. This is equivalent of almost nine bottles of hydrogen. It is said that purifying catalyst should last indefinitely unless poisoned by sulphur compounds, CO or some organic solvent vapors (rarely found in commercial hydrogen).—*Baker & Co., Inc., Newark 5, N. J.*

Please mention number 654 when filling out card

Porous Stainless Steel Spargers

New industrial gas dispersion units, in standard sizes, consist of a disk of porous stainless steel welded about its

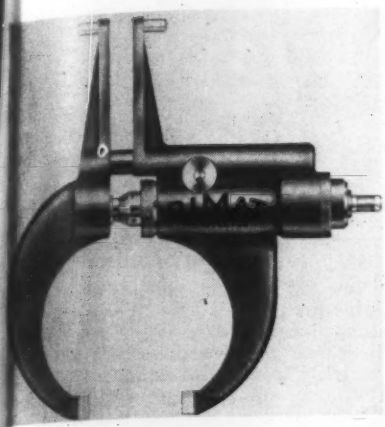


periphery to a shallow stainless steel dish welded to a standard female pipe connection. In use, required number of pipe connections are provided at bottom of tank, and spargers are then screwed into place. Porosities range from 5 to 65 microns. Flow capacities for all grades are said to be high, with unusually low pressure drops. Diameters available in porous elements are 1", 1½", 2⅜", and 3½"; pipe connection sizes are ⅛", ¼", ⅜" and ½". Special sizes and shapes can be supplied.—*Micro Metallic Corp., 193 Bradford St., Brooklyn 7, N. Y.*

Please mention number 655 when filling out card

Inside and Outside Micrometer

New "Rimat" duplex micrometer for internal and external measurements is announced in three sizes: 0-1", 1"-2",

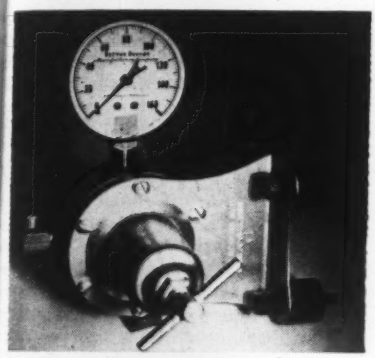


and 2"-3". Special sizes to order. Ends of measuring pins are hardened and ground on a radius for accuracy and to prevent cramping. All wearing surfaces are hardened and ground. All wearing surfaces can be readily adjusted.— *Richards Machine Tool Co., 124 South Isabel St., Glendale 5, Calif.*

Please mention number 656 when filling out card

Combination Reducing Valve and Gage

New combination reducing regulating valve and pressure gage is made in ¼", ⅜", ½" and ¾" pipe-size connec-



tions. Valve reduces line pressures to a desired lower working pressure (5 to 150 lbs./in.^{2}), automatically maintaining such pressure. Gage indicates regulated pressure. Each unit is provided with two rubber shock-absorbing vibration dampers. — *Dayton Rogers Mfg. Co., 2835 12th Ave. South, Minneapolis 7, Minn.*

Please mention number 657 when filling out card

Laboratory Mixer

New counter-rotating mixer is said to make available in the laboratory, mixing speeds and results hitherto obtainable only in large production equipment. Use of two motors, driving two propeller-equipped concentric counter-rotating shafts, produces annular rather than circular flow. All materials including heavier particles are rapidly drawn into the propellers where they pass through a shearing zone. It is said that there is practically no cavitation, no centrifugal effect, and liquid level remains essentially constant, allowing use of nearly-filled containers. Two 1/30-hp. motors allow relative speeds from approx. 200 to 12,000 rpm. and continuously-variable speed control is pro-

PERMOPIVOTS of PERMOMETAL*

*T.M. REG.

for PRECISION INSTRUMENTS

- LONG LIFE thru wear and vibration Resistance
- NON-ABRASIVE
- NON-MAGNETIC
- NON-CORROSIVE

For an illustrated description of how PERMOPIVOTS are made, ask for the new PERMOPIVOT booklet . . . Free on request.

PERMO INCORPORATED CHICAGO 26

MANUFACTURING METALLURGISTS

In the SPOTLIGHT

A precision ohmmeter for every job.

MODEL 246

Measures directly, accurately, instantly from 1 ohm to 100,000 ohms.

Ample long lasting power supply. Completely self-contained, using two No. 6 dry cells. • Individually calibrated wire wound resistors for extreme accuracy coupled with unusually long hand stepped meter scale. • Ruggedly built in sturdy metal, wrinkle finished case, which provides shielding from external magetic fields.

WRITE FOR BULLETIN No. 350

ASSOCIATED RESEARCH Incorporated

"Precision Instruments Since 1936" 233 South Green Street, Chicago 7, Ill.

Engineering Representatives in Principal Cities

Topflight Tape Instruction LABELS for Industrial Application

Well groomed, easy-to-read label product for instructions, trade-marks, codes, identifying marks, etc. Topflight Tape Labels apply instantly on metal, glass, wood, etc.

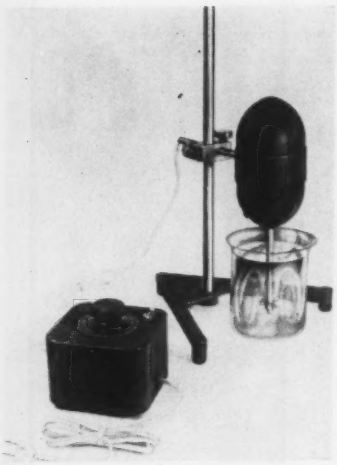
• *Write Today, for Industrial Samples!*

Topflight Tool Co.
Inc.
YORK - PA.

SALES PROMOTION ENGINEER

Leading manufacturer of industrial instruments has unusual opportunity for graduate engineer experienced in the pulp and paper or textile industries; or one with knowledge of process control instrumentation who is interested in applying this knowledge to these industries. Work consists of process control engineering, writing of quotations, order follow-up, and sales correspondence with branch offices and customers. Some traveling involved. Reply giving complete details of experience, education and personal history to Box 132, Instruments Publishing Co., 1117 Wolfendale St., Pittsburgh 12, Pa.

Manufacturer of industrial electronic instruments, established more than ten years, is open for representation in Southern Ohio, Michigan and Minnesota. Would like to hear from established organizations contacting power plants and process industries. Box 133. Instruments Publishing Co., 1117 Wolfendale St., Pittsburgh 12, Pa.

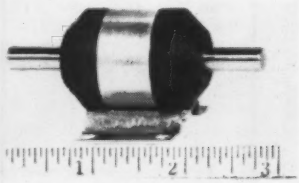


vided by a General Radio "Variac." For d-c. use, a rheostat can be supplied in place of the "Variac." New mixer comes complete as shown.—*Brookfield Engineering Labs., Inc., Stoughton, Mass.*

Please mention number 658 when filling out card

Miniature Speed Changers

New speed changers for instruments, etc., have over-all length of $2\frac{11}{16}$" and body diameter of $1\frac{1}{16}$", are available



in gear ratios of 15, 10, 9, 8, 7, 6, 5, 4, 3, 2, $\frac{3}{2}$, $\frac{4}{3}$, $\frac{5}{4}$, $\frac{6}{5}$, or $\frac{10}{9}$. Speeds up to 20,000 rpm. and torques up to 2 lb.-in. are permissible for some applications. Drive shafts are mounted in permanently-lubricated ball bearings, intermediate gears in graphitic plastic bearings.—*Metron Instrument Co., 432 Lincoln St., Denver 9, Colo.*

Please mention number 659 when filling out card

Accessories for Abrasion Tester

Three new accessories developed for use with "Taber Abraser" are announced: (1) Interval Timer (illustrated) enables research laboratory personnel to time abrasion tests within prescribed limits; (2) Duplex Refacing Stone for "Calibrase" abrading wheels assures more dependable standardization of wheels than previously possible,

also gives greater economy in use; the "Abraser Drymount," a dual-coated adhesive sheet, "anchors" thin flexible specimens to metal or cardboard backing to prevent wrinkling or buckling during test.—*Taber Instrument Corp., 111-I Goundry St., North Tonawanda, N. Y.*

Please mention number 660 when filling out card

"Y"-type Strainer

New "Y" type strainer is available in pipe sizes from $\frac{1}{8}$" to 2", in either cadmium-plated rust-resisting cast iron or all-bronze construction. New strainers are built to 250-lb. standards for cast iron, are suitable for 400-lb. service when furnished with bronze body. Is for immediate shipment.—*A. W. Cash Valve Mfg. Co., Decatur 60, Illinois.*

Please mention number 661 when filling out card

CONSISTENCY CONTROL

(Continued from page 540)

and the only question (whether "consistency head" coincides with "consistency" as discussed above) does not bear on the performance of whatever mechanism is selected to obey the commands of the primary element.

The next distinction made by Behar is: "(1) *Continuous;* (2) *Discontinuous,*" and he has often pointed out the advantages of continuous indications in automatic-control engineering. From Fig. 2 it is plain to see that the indication is continuous, eliminating the headaches of trying to speed-up an intermittent-sampling method of consistency measurement.

In discussing the "quality" of the indication fed to an automatic controller Behar explains that the *precision* must be related to the control application (pyrometry, etc.). It is plain to see from Figs. 3 and 5 that a change of one-tenth of one percent in consistency produces a change of $\frac{3}{4}$" in consistency head—more than ample for obtaining close control with simple, rugged mechanisms.

So then, if it is true, as Behar put it, that "no controller can be better than its primary measuring element," the new method gets over the first big hurdle. But the problem of automatic consistency control is made difficult by two things: First, the process lags involved; second, the relatively large power required to carry out the commands of the measuring system.

Experience to date seems to indicate that in any screen-room or wet-machine operation, process lags from 25 seconds initial reaction to 90 seconds complete reaction time are encountered. Inasmuch as in high-production mills at these low consistencies, flows up to 8000 gpm. are frequently encountered, it is obvious that automatic-control equipment of a high order of stabilization, speed and power is necessary if the requirements of successful control are to be fulfilled. Such equipment is available but this article is not the place for describing commercial products already known to most *Instruments* readers.

JOURNAL of the Instrument Society of America

Editor, R. R. PROCTOR, 2213 Ridge Ave., Evanston, Ill.

Vol. 2 JUNE 1947 No. 6

Editorial

Are Your Meetings Conducted Properly?

The Sections Committee of the I.S.A. has, we regret to say, been publicized very little in the columns of the *Journal*. Its work, however, has been carried on quietly and efficiently since the committee's inception several months ago, and at least eight new Sections have been formed or chartered as a result of the committee's efforts. The chairman of the Sections Committee is J. B. McMahon of Chicago, one of the four Vice-Presidents of the Society. Another Vice-President, H. H. Barnum of Detroit, and C. F. Goldcamp, Pittsburgh (Chairman of the Employment Committee), are the other members of the committee.

We recently had the pleasure of reading a report submitted by the Sections Committee to the Board of Directors, and it is, in our opinion, one of the most constructive reports we have ever seen. Among the many suggestions offered in this report are several regarding the conduct of meetings. We believe these suggestions should be brought to the attention of every national and sectional officer, committee chairman, technical chairman or other individual who at any time has or will have a part in the handling of any meeting. Therefore, at the risk of being accused of plagiarism, we would like to quote and expand a bit on the suggestions of the Sections Committee pertaining to the conduct of meetings.

Incidentally, the committee, and particularly "Mac" McMahon, has been getting around considerably, and the suggestions listed in the committee report are based on the observation of the operations of *more than half of the present Sections*. We feel that Mac knows whereof he speaks when he says that "In many cases . . . advice (on the conduct of meetings) is not necessary, but it is necessary often enough to make it worth while to mention (in this report)."

The first suggestion proposed by the committee, and probably the one which hits most of us in our weakest spot, is that meetings of all kinds conducted for the purpose of furthering the aims of the Society should be surrounded with some dignity and formality. This serves several purposes, not the least of which is its effect on guests and visitors. It lends an air of importance which is very helpful in persuading potential members of the value of the Society's existence. It increases the influence and the prestige of the officers or chairmen responsible for the meeting, and it makes for a more smoothly flowing meeting which is a source of satisfaction to all present.

Chairmen conducting business meetings should become acquainted with Robert's *Rules of Order;* each Section should own a copy and insist that it be used. If a copy is not available for the officers of your Section, it is our suggestion that your local Secretary be authorized to buy a copy and then, acting as librarian, check it out to the various officers and chairmen who will be responsible for the meetings to come. With so many Sections electing new officers for the 1947-48 season starting in September, now is the ideal time to see that this book is made available to the new officers, some of whom may never have conducted a meeting before.

Another of the Section Committee's suggestions is that each Section have an active Properties Committee—or make one person on the Program, Housing, or Arrangements Committee responsible for seeing to it that properties are available and on hand when needed. Such properties include projectors, screens, pointers, blackboard, chalk, eraser, water pitcher and glass, etc. It is rather disconcerting to a speaker to find at the last minute that someone forgot the extension cord for the projector and that, as a result, he cannot use his slides, or that there is no chalk on the blackboard just as he is about to illustrate an important point.

In this same connection, it is certainly not fair—in fact, it is a serious offense—to ask the speaker to provide his own paraphernalia such as projectors, screens, etc. His needs should be ascertained far enough in advance by the chairman of the meeting so that *everything necessary* will be on hand when the meeting opens. Further, if slides are used, someone familiar with the operation of the projector should be assigned to the job of running it. It is true that even the best operators sometimes get a slide in upside down, but this is not the way to bring a laugh into the scene. Let the speaker do that if he is so inclined. Careful handling of the slides will minimize this sort of interruption, and if your operator can't recognize an out-of-focus condition on the screen—and correct it—it's time to get another operator!

Speakers should be treated with consideration. This implies that, among other things, meetings should be started on time. It is not fair to anyone present, and most of all the speaker, to postpone starting the meeting for perhaps a half-hour or an hour waiting for the audience to straggle in. (This works both ways; it is likewise thoughtless of the speaker to arrive late or to arrive unprepared and require time to get his papers, slides or equipment ready. However, as members of the audience, we should make every effort to be there on time so the speaker will not be disturbed by too many late-comers, and if we are responsible for the conduct of the meeting, we should make every effort to have everyone present on time and start the meeting as per schedule.)

Due to space limitations, there are many other things which will have to remain unsaid in this editorial, including other minor suggestions by the Sections Committee, but it is hoped that the few suggestions we have made or quoted herein will be sufficient to encourage all those responsible for the handling of Society meetings of any sort to conduct them as they should be conducted. As the Society grows in size, it must and will also grow in its importance among other engineering and technical societies, and its prestige and influence, as well as its value to its members, depends in no small way upon the efficiency and propriety with which its meetings are conducted. We can all do our share toward furthering this effort. —RRP

Editor's Notes

1. Who's Who

The "officer of the month" this time in our "Who's Who" column is Dr. Ralph H. Munch, Vice-President, of St. Louis, who was until recently also Chairman of the St. Louis Section. Appropriately enough, our Delegate this month is William E. Boyle, also from St. Louis, and it is a coincidence that "Bill' is also a member of the committee whose chairman occupies the third "seat" in this month's "Who's Who" department. Our committee chairman this time is F. H. Trapnell, or "Trap" as he is called, who heads the Recommended Practices Committee. It is not a coincidence that some of the activities of Trap's committee are also written up in this issue of the *Journal*, since it is this kind of "pairing-up" that we strive for each month.

2. Exhibit Information Released

Elsewhere in this issue will be found the latest information released by the National Office on the status of the 1947 Exhibit to be held in Chicago this coming September 8th to 12th inclusive. The floor plan of the Stevens Hotel Exhibition Hall is shown with all spaces reserved to date indicated in color. In conjunction with this diagram is the latest list of exhibitors who had contracted for space as of press time for this issue.

As can be seen on this diagram, there are but a few spaces as yet unsold, and there are applications pending for some of these, according to T. G. Robinson, chairman of the Exhibit Committee, and D. J. Bergman, chairman of the Space Allocations Committee. From all indications to date, the show will be a complete sell-out. This, in conjunction with the excellent technical Conference being arranged (some of the papers for which are listed also in this issue) promises one of the finest and most instructive conferences ever to be arranged in this country for men in

Continued on page 572

Surface Finish Measurement Instrumentation

By JAMES A. BROADSTON, North American Aviation, Inc., Los Angeles

(Concluded from April)

No attempt will be made to go into the details of operation of the various types of surface finish measuring devices because much has already been written and published that discusses these devices thoroughly. Those who are interested in the practical side of the problem are not concerned anyway as long as a satisfactory index to the surface quality can be obtained without damaging the parts.

Challenge To Technicians

For those who are technicians, electronic experts and instrument designers, and who are interested in accepting the challenge for the improvement of surface finish measurement instrumentation, a few remarks follow that will assist in becoming familiar with some of the problems involved.

In the first place there are so many different types of surfaces that it would be impossible even to count them. To the naked eye, we have the surfaces of a wire mesh screen, the plastered wall, the granite building, an alligator's skin, a fuzzy peach and many others, each completely different. When we take a small magnifier we find almost everything we own has a characteristic surface texture. Consider as examples pieces of paper, leather, canvas, cloth, wood, linoleum, wallboard. Each is different than the other. Even by the eye alone it is easy to distinguish between the machine finishes produced by milling, turning, lapping, honing, grinding, etc., as each process leaves a different characteristic surface roughness.

When it is realized that there are not only so many different types of surfaces, but also many degrees of roughness for each it is not surprising that no one has yet found a surface finish measuring instrument that can begin to do the whole job. One should not, therefore, be too critical of existing instrumentation. Many smart men and many technical groups have studied the problem without startling results. It still holds a challenge for the instrumentation industry to do better. Even existing instruments of a type often do not give the same reading on a given specimen. Even our practical man doesn't want that.

Instrumentation Advances Art

Surface finish measurement instrumentation should be considered to include not only commercially available instruments such as tracer point analyzers, optical comparators, reflectivity or gloss meters and sample roughness blocks, either originals or replicas, but also all other devices for the purpose that have been used experimentally.

Tracer point analyzers have contributed more to the advancement of surface quality control than any other single factor. With all their precision as instruments, however, a recent unbiased study conducted by the National Bureau of Standards and the Army Ordnance Department showed that their readings are not always consistent or dependable over a wide range of surfaces. The fact that the tracer point itself induces certain errors due to its inability to precisely follow all of the surface irregularities, plus inherent differences in the response characteristics of the pickups, amplifiers and meters involved makes duplication of results quite difficult. There is still much room for improvement.

It is this inability to duplicate readings that is delaying national standardization of surface roughness symbolism for machined parts. No one has yet designed a surface roughness measuring instrument that can be produced in quantity and yet maintain its accuracy or calibration so that all instruments will give the same reading on any given surface. The problem is not an easy one.

Performance Criteria Needed

Another consideration is that no generally acceptable criteria have ever been evolved that will truly correlate the performance of different machine finishes. This is largely due to the fact that so many factors are involved. Different materials, various types of finishes and thousands of applications make the problem of correlating performance more difficult.

Further, no agency has ever taken over a project to make a thorough and careful study of the results and observations of the many investigators. No attempt has ever been made to correlate them, to make tests to confirm or discount their findings, or to determine if there might be a sound fundamental basis on which such performance can be measured and predicted. Such a program might well fit into the research facilities of a large university if industry is willing to help finance the project and take enough interest in it to assist and guide its work so that the results will be worthwhile.

As a result, it is doubtful if the so-called RMS (root-mean-square) average deviation from the mean in microinches (which is the generally accepted

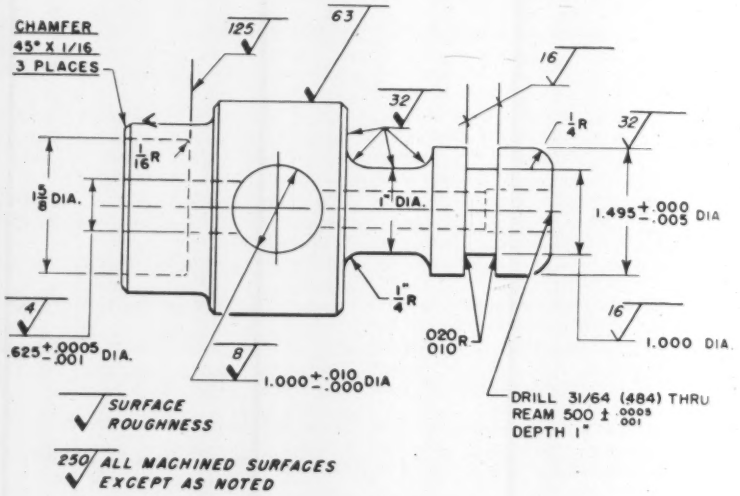


Fig. 6. Typical applications of surface roughness symbols (flags optional).

A recent survey conducted among the leading aircraft manufacturers by the National Aircraft Standards Committee revealed a preference for using the arithmetical average of by a vote of 2 to 2. This preference was solicited in the interest of simplification, since it appears that the difference between the two units is less than the acceptable tolerances and within the accuracy range of existing instrumentation.

Progress Requires that Fundamentals Be Established

H. Wright Baker, D.Sc., M.I., Mech. E., M.I. Aut. E., Professor of Mechani

cal Engineering for, I believe, the University of London, in introducing a "Report on the Measurement of Surface Finish by Stylus Methods" published in 1944 by the Research Department of Taylor, Taylor & Hobson, Ltd., of Leicester, England says:

"In the development of new technical processes it is of primary importance that the fundamental principles upon which they depend should be established as early as possible if misunderstandings and mistakes are to be avoided and steady progress is to be made.

"Taylor, Taylor & Hobson, Ltd., have rendered a notable service to engineers by preparing and publishing a concise and thorough report on the principles underlying the action of stylus instruments, the interpretation of surface records, and the limitations to be considered.

"This account of their own pioneering work, giving indications of further data which needs to be acquired, should provide a stimulus to other workers and contribute much towards establishing our knowledge of Surface Finish on a broad scientific basis."

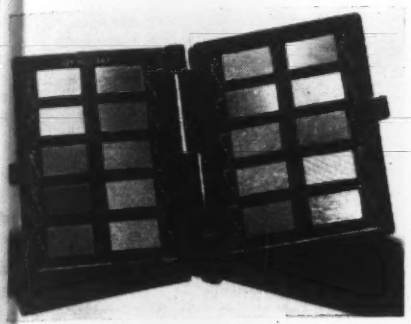


Fig. 7. Stainless steel specimens. (Courtesy University Machine Co.)

No further recommendation of this excellent work is necessary. The serious researcher into these problems would do well to read it and profit thereby.

Practical Application Now Possible

The practical man should not allow these facts to worry him unduly for with any given instrument he can control the processing of his product within extremely close limits. By making samples of the surfaces that have given satisfactory performance, he can, by direct instrument comparison, keep all further production under control. This is particularly true for very fine surfaces that are very essential to the continued satisfactory performance and life of his product. The Profilometer, manufactured by Physicists Research Company of Ann Arbor, Michigan, and the Brush Surface Analyzer manufactured by the Brush Development Company, Cleveland, Ohio, are tracer point surface finish measuring instruments suitable for such work. The Comtor Surface Finish Comparator manufactured by the Comtor Company of Waltham, Massachusetts, is one of the reflectivity types of comparators. It is equipped with a light source and a photoelectric cell which measures the light reflected from the surface to be compared with the sample. The meter reading serves as an index to the surface roughness. It is also quite suitable for very finely finished parts.

Samples Distributed for Control

While nothing will take the place of these precision instruments in measuring, or shall we say comparing, the surface roughness of very fine machine finishes, there are many rougher surfaces that also need adequate control in the shop. Many manufacturers have found that the procurement of sets of standard surface finish samples for distribution to their workers has solved the problem as far as the average machine finishes are concerned. This can usually be done for an expenditure of considerably less than one hundred dollars if the plant is not too large, whereas even one tracer point analyzer costs over a thousand dollars. In many cases, even such an expense is justified; some manufacturers have dozens of tracer point analyzers in one department. In other cases, it may not be justified and for those the use of standard roughness samples accomplishes the required control.

Control Requires Drawing Designation

Both methods, however, require the use of a proper system of drawing designation. One method now in use by industrialists all over the world is described in my text titled "Control of Surface Quality," available from the Surface Checking Gage Company, Hollywood 28, California. Such a method of drawing designation and quality control (See Fig. 6) can be accomplished by using as a reference a set of standard roughness samples. There are several types available and any of these which appeal to the user can be used in such a program. Those of the University Machine Company, Cambridge, Massachusetts are among the best stainless steel machined specimens obtainable for purposes of comparison (Fig. 7). The Norton Company of Worcester, Massachusetts, makes an excellent set of surface roughness standards depicting various grinding finishes that are also the original machined samples (Fig. 8).

Manufacturers of Replica Standards

In the field of replica standards there are several manufacturers: General Electric Company, Schenectady 5, New York (Fig. 9); U. S. Rubber Company, Electroforming Dept., Detroit, Michigan (Figs. 10 and 11); Surface Checking Gage Company, Hollywood 28, California (Fig. 12); NH Gage Company, North Hollywood, California (Fig. 13).

These replica standards have many advantages, too. Their lower cost permits a wider distribution, hence it is easier for all personnel along the line to check conformance with surface finish requirements. The engineer, inspector, machinist, assembler and everyone connected with the control of surface quality can easily, by fingernail comparison of the parts with the samples, tell if the parts are satisfactory insofar as surface finish is concerned.

Fingernail Comparison Detects Roughness

Comparison is made by drawing the sharp fingernail lightly across the surface of the standard roughness specimen prepared by a similar process and then across the machined surface of the part whose roughness limits are being checked. It is easy to tell which of the two surfaces is the rougher. By comparison with another of the standard roughness blocks, the finish of the part can be closely estimated.

Many times it has been shown that even an inexperienced person can immediately detect a difference of only a few microinches on some types of surfaces. It might be said that, when used in conjunction with a standard set of surface roughness blocks, each finger is equally sensitive to an instrument

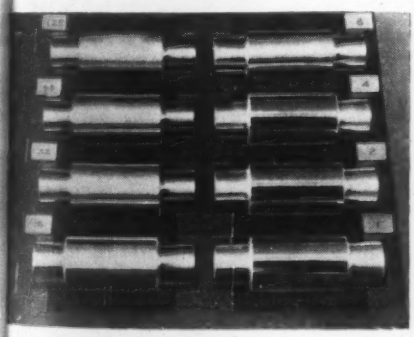


Fig. 8. Sample roll specimens. (Courtesy Norton Co.)

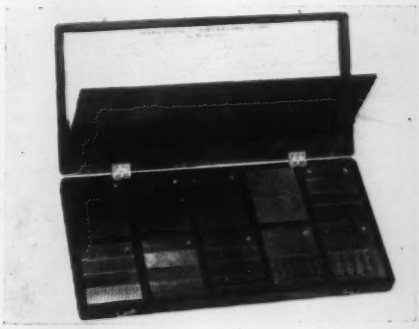


Fig. 9. Standard roughness specimens. (Courtesy General Electric Co.)

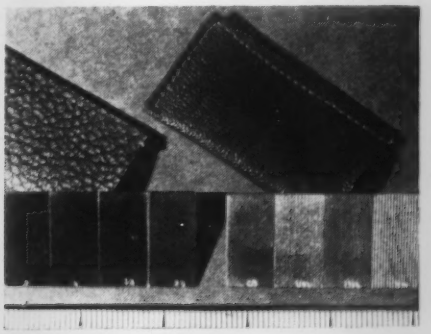


Fig. 10. Surface roughness comparators, pocket size. (Courtesy U. S. Rubber Co.)

Fig. 11. Surface roughness comparators, large size. (Courtesy U. S. Rubber Co.)

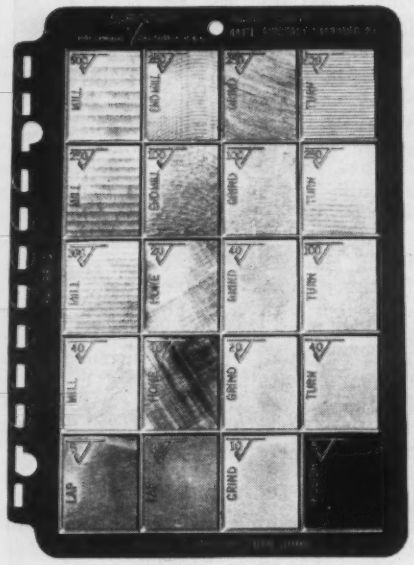


Fig. 12. Surface roughness standards. (Courtesy Surface Checking Gage Co.)

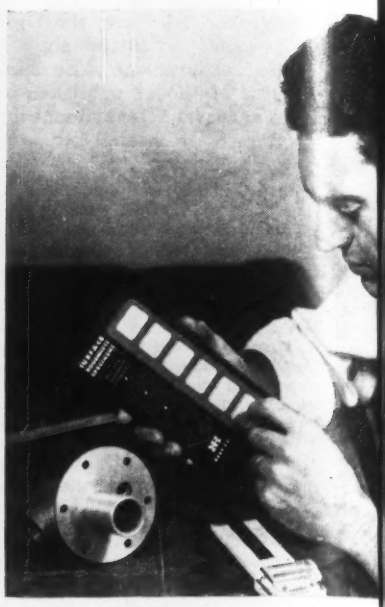


Fig. 13. Surface roughness specimens in use by engineer. (Courtesy NH Gage Co.)

worth over one thousand dollars. Each worker having ten fingers carries about ten thousand dollars worth of surface finish measurement instrumentation with him. All the practical man must do to use this abundant supply of instrumentation is to train his workers properly, adopt an acceptable method of drawing designation and supply the roughness standards for reference. For the rougher surfaces that are not critical from a performance standpoint, visual comparison with the standard surfaces has proved sufficiently accurate.

There are many other methods for evaluating surface finish that have not been successful enough to leave the laboratory. Others have helped immeasurably in certain applications.

Among these may be mentioned taper sectioning; the use of a phonograph pickup for comparison; optical sectioning by a straight edge shadow; film replicas for projection; taper sectioning by inclined light beam; air leakage or light leakage between the surface and a standard orifice; friction tests; oil adhesion tests; and honing stick tests. There is not time for a discussion of each of these, but reference to existing literature on the subject will reveal greater details about them.

Surface finish measurement instrumentation has already contributed a great deal toward the improvement of the science of interchangeable manufacture. With proper application, it can easily contribute a great deal more. With such great opportunities ahead for improved instrumentation, as well as improved utilization, the day may not be far off when the use of surface finish control will be as universal as dimension control is today.

Editor's Notes

(Continued from page 569)

all phases of the instrument field. *Now is the time to make plans to attend this Conference and Exhibit.*

3. THE NEEDLE POINTS TO—

Aruba—for the report of a most unusual "sales" type of meeting, but an excellent idea at that.

New York and Oak Ridge—for exceptionally well written and interesting reports. New York's required no editing whatsoever!

Little Needles (honorable mention) to Chicago, Detroit, Philadelphia and St. Louis for generally good reports.

—R. R. PROCTOR

Official News

TO ALL SECTION SECRETARIES

Here are some additional changes to be made in the previously published list of Section Delegates, Secretaries and *Journal* Correspondents:

1. New Secretary. St. Louis Section, William G. Lee, National Lead Co., St. Louis, Mo. (Delegate, W. E. Boyle; Correspondent, H. E. Zeffren; as before.)

2. New Correspondent. Northern Indiana Section, Edward L. White, 8833 Carolina Ave., Highland, Ind.

PAPERS NOW SCHEDULED FOR 1947 CONFERENCE

According to a recent announcement by the Papers Committee, most of the speakers and papers scheduled for the Second National Instrument Conference and Exhibit to be held in Chicago, September 8-12, 1947, have been arranged for. Following is a list of those already scheduled:

"Instrumentation Practices in the Oil Industry" by G. L. Larson (Texas Co.)

"Instrumentation Practices in the Steel Industry" by H. Morrow (Carnegie-Illinois Steel Company)

"Instrumentation Practices in the Chemical Industry" (speaker announced later).

"Instrumentation Practices in the Power Industry" (speaker announced later).

"Dew Point Recorder" by B. Suomi (University of Chicago).

"Quantometer" by J. R. Churchill (Res. Lab., Aluminum Co. of America).

"Quality Control—A Management Tool for Process Industries," by W. E. Jones (Management Consultant).

"Precision of Measurements" by F. Trowbridge (Sentinel Radio Company).

"Instrumentation of an Acetic Acid Concentration Process" by J. E. Voytilla (E. I. duPont de Nemours & Co.)

"Instrumentation of Process of Extracting Bromine from Sea Water for Production of Ethylene-Dibromide" by P. Hart (Dow Chemical Co.).

"Measurement & Control of Viscosity" by D. J. Pompeo (Shell Development Co.).

"Polarographic Analysis — Principles, Techniques, and Applications" by L. D. Wilson (Corn Products Company).

"Adaption of the General Electric Spectrophotometer for Special Measurements" by E. I. Stearns (Calco Chemical Co.).

"Instrumentation of an Alkylation Plant" by H. Moore (Std. Oil Co. of N. J.).

"Water Conditioning and Steam Plant Control with Conventional Industrial Instruments" by W. H. Fortney (Humble Oil Company).

RECOMMENDED PRACTICES COMMITTEE NOW AT WORK ON SEVERAL PROJECTS

One of the most important committees of the Society, the Recommended Practices Committee has almost completed two of its projects, has several others under way at present, and is shortly to undertake several more, according to recent information from F. H. Trapnell, chairman. A recent letter from Mr. Trapnell lists the names of the members of the committee:

F. H. Trapnell, Chairman, 711 Bellevue Road, Wilmington 280, Del. (Phila. Sec.)

A. F. Sperry, Acting Secretary, 225 W. Michigan Ave., Chicago 1, Ill. (Chi. Sec.)

W. E. Boyle, St. Louis Section.

W. G. Brombacher, Washington Section.

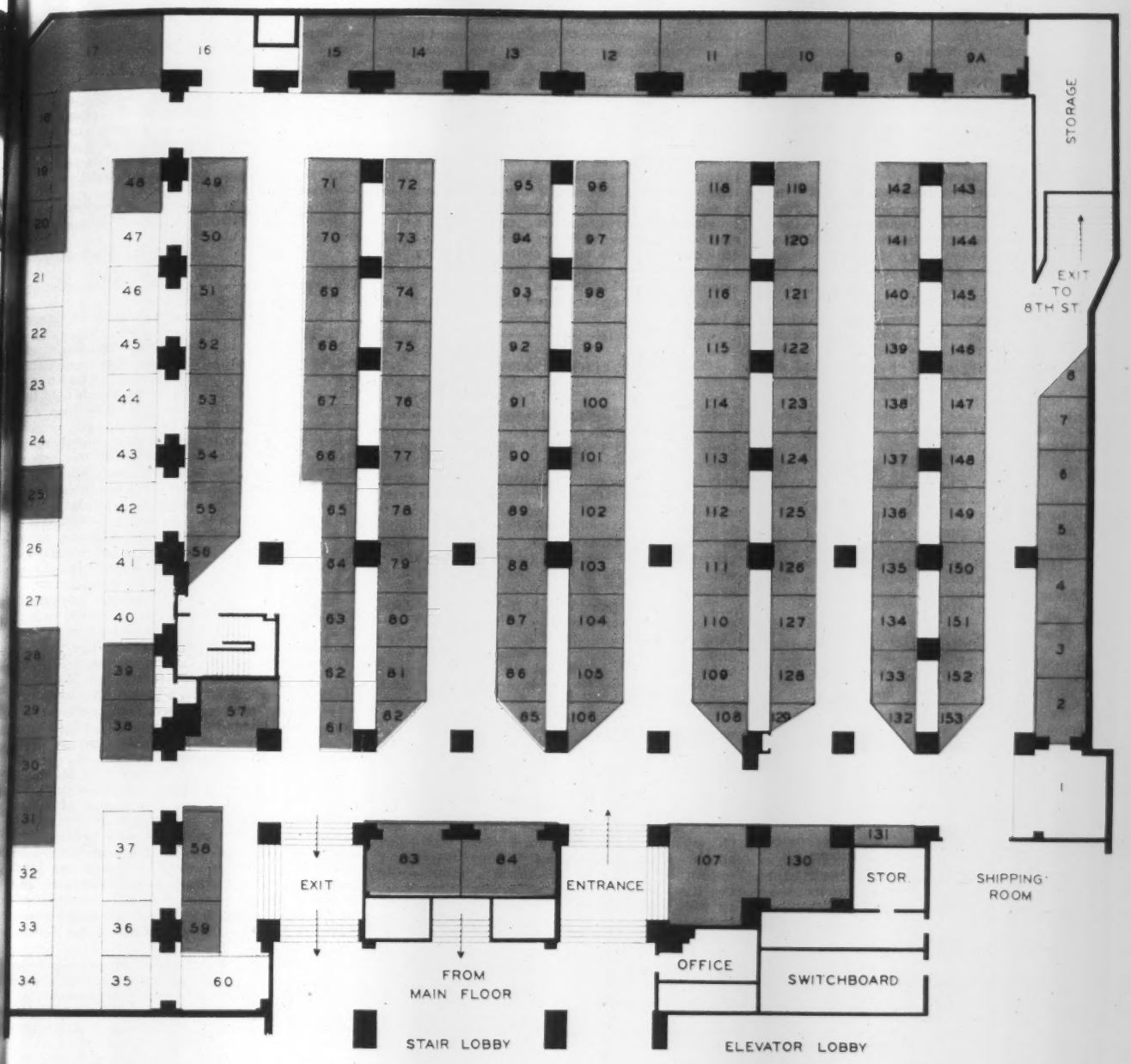
A. L. Chaplin, New Jersey Section.

W. A. Crawford, Philadelphia Section.

W. H. Fortney, Baytown, Texas (not member).

R. L. Galley, Philadelphia Section.

Continued on page



SPACE RESERVED TO DATE (SHOWN IN GREEN), SECOND ANNUAL INSTRUMENT CONFERENCE AND EXHIBIT.

EXHIBITORS TO DATE

Aeroquip Co., Inc.
Aircraft-Marine Products, Inc.
A. S. Aloe Co.
American Meter Co.
Askania Regulator Co.
Associated Research, Inc.
Autoflight Instrument Div., G. M. Giannini & Co., Inc.
Autotron Co.
Bailey Meter Co.
Baird Associates
Barton Instrument Co.
James G. Biddle Co.
Bristol Co.
Brookfield Engineering Labs.
Brown Instrument Co.
Brush Development Co.
Builders-Providence, Inc.
Buffalo Meter Co.
Burgess Battery Co.
Caldwell-Clements, Inc.
Carson Micrometer Co.
Chicago Metal Hose Co.
Commercial Research Labs.
Conoflow Corp.
Consolidated Engineering Corp.
Continental Equipment Co.
R. W. Cramer Co., Inc.
Davis Emergency Equipment Co.
F. W. Dwyer Mfg. Co.
Electro Products Labs., Inc.
Ellison Draft Gage Co., Inc.
Engis Equipment Co.
Equipoise Controls
Esterline-Angus Co.
Fischer & Porter Co.
Fisher Governor Co.
Foxboro Co.
Fulton Sylphon Co.
Gaertner Scientific Corp.
General Electric Co.
General Meters & Controls Co.
Claud S. Gordon Co.
Gotham Instrument Co.
Gow-Mac Instrument Co.
Hagan Corp.
Hammel-Dahl Co.
Hays Corp.
H-B Instrument Co.
Helicoid Gage Div., American Chain & Cable Co.
Illinois Testing Labs., Inc.
Industrial Instruments, Inc.
Instruments Publishing Co.
J-B-T Instruments, Inc.
Jerguson Gage & Valve Co.
Kieley & Mueller, Inc.
Leeds & Northrup Co.
Leslie Co.
Linde Air Products Co.
Liquidometer Corp.
Macbeth Corp.
Magnetrol, Inc.
Manning, Maxwell & Moore, Inc.
Mason-Neilan Regulator Co.
McAlear Mfg. Div., Climax Industries, Inc.
Mercoid Corp.
Meriam Instrument Co.
Mine Safety Appliances Co.
J. W. Murphy Co.
Murphy & Dickey Co.
Nielsen & Fryer
Palmer Thermometers, Inc.
Paragon Electric Co.
Penn Industrial Instrument Corp.
Permo, Inc.
Permutit Co.
Photoswitch, Inc.
Physicists Research Co.
Plummer & Kershaw
Precision Thermometer & Inst. Co.
Production Instrument Co.
R-S Products Corp.
Refinery Supply Co.
Republic Flow Meters Co.
Roller-Smith Div., Realty and Industrial Corp.
Rowe Radio Research Lab. Co.
Sarco Co., Inc.
Schutte & Koerting Co.
Seedburo Equipment Co.
Seely Instrument Co., Inc.
Shallcross Mfg. Co.
Simplex Valve & Meter Co.
Simpson Electric Co.
Sorensen & Co.
South Bend Lathe Works
Herman H. Sticht Co.
Standard Electric Time Co.
Superior Electric Co.
Surty Co.
C. J. Tagliabue Div., Portable Products Corp.
Taylor Instrument Cos.
Telechron, Inc.
H. O. Trerice Co.
Trimount Instrument Co.
Trinity Equipment Corp.
Triplett Electrical Instrument Co.
Veeder-Root, Inc.
Vernon-Benshoff Co.
Victoreen Instrument Co.
Walker-Jimieson, Inc.
Wallace & Tiernan Products Co., Inc.
W. M. Welch Scientific Co.
Weston Electrical Instrument Co.
Wheelco Instruments Co.
H. A. Wilson Co.
John Worley Jewel Co.

Porter Hart, Freeport, Texas (non-member).

David Hostelder, New Jersey Section.

J. Johnston, Jr., Philadelphia Section.

J. C. Kerley, New Jersey Section.

Anker E. Krogh, S.A.M.A. Representative (also I.S.A., Phila. Sec.).

H. M. McCarthy, New Jersey Section.

H. F. Moore, New Jersey Section.

A. Novak, Oak Ridge Section.

R. D. Webb, Charleston Section.

The following sub-committee chairmen have been actively engaged for some months on the projects assigned to them and it is expected that the results of their work will be released very shortly:

H. M. McCarthy—Thermocouple and Extension Wire Standards.

W. G. Brombacher—Manometer Tables.

Other sub-committees which have been activated and have done some preliminary work are as follows:

Flowmeter Installation Practices—R. L. Galley, Chairman. This subject is one of wide scope, and initial efforts are being directed to the release of recommended practices on accessories, such as seals, condensate chambers, etc.

Instrumentation Flow Plan Symbols—David Hostelder, Chairman. A very broad cross-section of users is being canvassed in order to be certain that all systems now in use may be thoroughly considered in the preparation of recommended standards for these symbols. It is planned that the system will also include a comprehensive system for identification numbering and lettering of instrument items.

Recommended Practices for Control Valve and By-pass Installations—W. H. Fortney, Chairman. This sub-committee was only recently set up (April) and no information has as yet been received concerning its activities.

Recommended Practice for Pneumatic Transmission Pressure Range—J. C. Kerley, Chairman. This sub-committee was likewise activated in April, but at a meeting in Cleveland on April 23, it was unanimously agreed to accept the tentative standards proposed by the S.A.M.A. committee working on the same project. Agreement was reached on the following points:

1. Supply pressure for controllers to be not less than 18 and not more than 20 p.s.i.
2. Pressure range for diaphragm motors to be 3 to 15 p.s.i.
3. Pressure range for pneumatic transmitters and receivers as well as for positioning control indices to be 3 to 15 p.s.i.

In addition to the above sub-committees already at work, sub-committees will be appointed as soon as possible to undertake approved projects selected from the following suggested list:

Capillary Protection, Instrument Tubing Supports, Instrument Panel Curbs, Instrument Panel Sections, Alarm Circuits, Outside Instrument Protective Cabinets, Pneumatic Control Circuit Pressure Tests, and Explosion Proof Equipment.

The Committee on Committees, under the chairmanship of W. A. Wildhack, has specified that "The Recommended Practices Committee shall study technical practices in instrumentation and prepare and recommend uniform practices where adoption of such uniformity would simplify work or facilitate general understanding and interchange of information, and promote their general adoption." The Recommended Practices Committee has, according to Mr. Trapnell, approved and accepted this basis of operation, and has in addition adopted a resolution that the committee is in favor of the proposal that the Publications Committee set up a loose-leaf binder system to be issued to all I.S.A. members to include all pertinent and permanent Society literature and to include in such binder a section reserved for the Recommended Practices Committee issues and reports.

The commitee is also requesting that an invitation be extended to the A.S.M.E., Industrial Instruments and Regulators Division, to appoint a liaison member to the I.S.A. Recommended Practices Committee. The Engineering Group of the Recorder Controller Section of S.A.M.A. is already officially represented on the Recommended Practices Committee by Mr. Anker E. Krogh, Brown Instrument Company. It is expected that the A.S.A. will also be represented on the committee soon.

Mr. Trapnell is to be commended on the progress he has made in organizing the Recommended Practices Committee, and it is expected that the recommendations soon to start appearing as a result of the committee's efforts will have a far-reaching effect in both the I.S.A. and in industry.

The next meeting of the committee is scheduled for 12:30 p.m. on Sunday, September 7, 1947, at the Hotel Stevens in Chicago.

Section News

ARUBA

The ninth meeting of the Aruba Section took place on May 6th at the Engineers' Club Building. President MacNutt opened the meeting by exhibiting our recently-received Statutes (or Constitution) signed by the Governor of Curacao Territory. His signature made ours a legal organization as of November 5, 1946. Since the document is in Dutch and most of us are yankees this might lead to some fancy translations when our Holland-born members are not present.

The evening was much livelier than usual. Perhaps this was due to the seating arrangement which gave it all the appearances of a regular "bull session." Anyway, there was a very satisfactory membership participation in the evening's events and reports.

The main event of the evening was a panel discussion arranged by Bill Hughes and his associates on the Project Committee. The purpose of the discussion was to find out what the majority of members desired in the way of meetings, projects, programs, etc.

Art Krottnauer, Bob MacMillan, Lyle McGrew and Stan Chapman were informal speakers on the subject "What benefits I expect to derive by becoming a member of the Instrument Society of Aruba." Art pretty well voiced the opinion of the group during his discussion of (1) Education, and what he thought he would get along this line from the I.S.A., (2) the social aspect of such a group of fellows with something in common, (3) the prestige of being one of a well-organized group, (4) publications available to members, (5) trade contacts, with possibilities of establishing contacts through such an organization which might lead to a better position or an "inside track" not otherwise likely to happen, (6) a matter of good policy to belong to an organization associated with or representing your trade or profession, (7) a possible means of keeping up with new developments, (8) a growing Society with so many possibilities and such a bright future that it is worth joining in the "early days."

Participation in the following discussion period was pretty general and several workable ideas were brought out for the Project Committee to consider. We adjourned at 9:30 and made quite a dent in the pile of sandwiches, doughnuts and coffee supplied through the efforts of the Social and Recreation Committee.

—J. L. Lopez, *Sec'y*

CHICAGO

The final meeting of the season for the Chicago Section was a very successful dinner-dance and social evening in conjunction with the annual business meeting at which the new officers for the 1947-48 season were installed. Starting with a social hour in the cocktail lounge, with music by The Three Revelers, the meeting continued with dinner and entertainment in the beautiful Furniture Club of America. Dancing and community singing prolonged the dinner hour until after 8:30.

President Bob Proctor opened the formal business meeting with a brief report on the accomplishments of the Section and of the Society during the past season, following which Treasurer Kraybill presented the financial report of the Section. Chairman Riggs of the Nominating Committee then announced the winners of the election of officers for the coming season, following which Mr. Proctor, on behalf of the Executive Committee, formally declared the winners elected, and turned the meeting over to the new President.

The officers for the coming season are:

President: Stanley A. Gray, Minneapolis Honeywell Regulator Co.

Vice-President: Ralph R. Siechen, Universal Oil Products Co.

Treasurer: J. H. (Jack) Cuthbert, Carnegie-Illinois Steel Corp.

Floyd E. Ertsman will continue as Executive Secretary of the Section.

With President Gray presiding, the meeting was then turned over to Master of Ceremonies Dick Schoenfeld, who presented three entertainment features which held the audience until almost 11 p.m. The first was the presentation of a $20 hat (gift certificate) to the winner of the membership drive. Several members tied for the honor so Chairman Charlie Hurst and John Havens of the Membership Committee conducted a drawing to see who won the hat. Miss Sylva Mae Dushkis, the only woman member of the Section, drew the winning name from a hat, and the prize went to Harold Haskett, the Instruments Publishing Company representative in Chicago.

Following the prize drawing, "professor" Don Nielsen presented the "technical paper" of the evening, a hilarious "scientific" report on "Distribution Coefficients." The feature of the evening was then presented—John Booth, professional magician, in "An Hour of Magic and Mind-Reading." The audience was highly pleased with the performance, and everyone, including the wives and sweethearts, agreed that this type of meeting should be an annual affair.

At the unscheduled "Users' Pep Meeting" held on May 5, a number of users gathered for an informal open discussion at which their complaints, suggestions, criticisms, ideas, and offers of help were brought out into the open and aired thoroughly. A good many suggestions were developed for presentation to the incoming Program and Housing Committees, and it is to be hoped that the meeting will result in greater user participation in the activities of the Section in the future.

Outside of the rather intense activity scheduled for the summer in preparation for the Second National Instrument Conference and Exhibit to be held here September 8th to 12th, no meetings are scheduled until the first Monday in October.

We'll see you all in Chicago in September.

—John C. Vaaler, *Corr.*

CUMBERLAND

The Cumberland Section held its regular dinner and technical meeting Tuesday, April 29, at the Queen City Hotel. The speaker for the evening was W. F. Pray, Askania Regulator Company, who spoke on the subject "Automatic Proportioning of Gases and Liquids." He very ably handled the subject in the absence of H. J. Velton, who was originally scheduled to present the talk.

Mr. Pray was accompanied by E. R. Engstrom, Manager of the Pittsburgh Division of Askania Regulator Co. We were glad to also welcome S. C. Gewin of the Bristol Company as a guest.

The next meeting will be on Tuesday, May 27. The speaker is to be W. W. Witters, Sales Manager for Automatic Temperature Control Company, and the subject will be "Time Controls in Industry."

—H. E. Bishop, *Corr.*

DETROIT

The April meeting of the Detroit Section presented a talk by O. G. Rutemiller on the "Motron" Servomechanism. The speaker is a consulting engineer whose background includes work with Westinghouse, the Crosley Corporation, and the W. C. Robinette

Company, manufacturers of the servo-mechanism under discussion.

George M. Chute, Chairman of the Michigan Section, A.I.E.E., acted as technical chairman.

Mr. Rutemiller's talk, illustrated by slides, explained the operation of the instrument, covered its basic theory, and outlined several interesting control applications. One of the slides showed the mechanism used in mixing two oils at the rate of 50 gpm to give an end product that could be kept within a viscosity of 2 Saybolt units at 150 Saybolt. Other uses mentioned included control of air streams, process level and fabric or thread tension.

The Motron Servo responds to an input of one-half inch-ounce and provides a maximum of 75 inch-pounds output—a torque adequate to actuate most valves, dampers and controls originally designed for manual operation.

Guests at the meeting included several faculty members of the University of Michigan at Ann Arbor. Professor Stout, who conducts a course in instrumentation at the University, expressed great interest in the activities of the I.S.A. and of this Section.

Wheelco instruments were featured at the exhibit for this meeting, and drew a large and interested audience.

The next meeting of the Section will be held on Tuesday, May 27 at 8:00 p.m. in the Junior Room of the Horace H. Rackham Building. The subject, "Telemetering Problems in Modern Flight Research," will be discussed by M. H. Nichols, of the Aeronautical Research Center of the University of Michigan. The monthly exhibit will feature products of the Taco-West Corporation, Chicago, with H. H. Barnum in charge of the demonstration.

The June 23d meeting will feature representatives from Micromatic Hone Corporation (Monarch Machine Tool Company) and Moore Products Company, who will discuss the subject "Automatic Controls for Production Machinery."

—SIEGMUND KULKA, *Corr.*

EASTERN NEW YORK

At the May 6th meeting of the Eastern New York Section, L. F. Parachini, of the Weston Electrical Instrument Company, spoke on "Behind the Instrument Dial," a talk concerned with the basic mechanisms in general use for moving a pointer across a scale. As the lecture progressed, he illustrated it with many of the various types of panel instruments.

The Albany Felt Company has very graciously invited the Eastern New York Section to hold its June 3rd meeting at their plant, Albany-Menands Road (North Broadway), Albany. There will be an inspection trip through the plant after the regular business meeting, which will convene at 8:00 p.m.

The plant inspection trip is to be made with particular attention being given to instrumentation involved in the manufacture of felts. Due to the nature of the meeting, it is limited to members only.

—W. J. CLAFFIE, JR., *Sec'y.*

GULF COAST

The April meeting of the Gulf Coast Section was held Monday, April 21, at Lamar College in Beaumont, with sixty-two members and guests present.

R. M. Howe, Program Committee Chairman, announced that Leeds & Northrup Co. was scheduled for May and the Fisher Governor Co. for the month of June.

Section President T. H. Pierson introduced the speaker of the evening, D. W. Hilbourn, Service Engineer, Bailey Meter Company, whose slide-illustrated lecture was "Automatic Combustion Control as Applied to Boilers." Mr. Hilbourn's talk was informative and interesting. He described the operation of boilers and presented in considerable detail the fundamentals of combustion control.

Series and Parallel Control were explained, along with the operation and adjustments of the "Pilotrol," "Standatrol," and the "Averaging Relay."

A lively discussion and question and answer period followed the lecture, and the meeting adjourned at 10:30 p.m.

—A. E. BUNN, *Sec'y-Treas.*

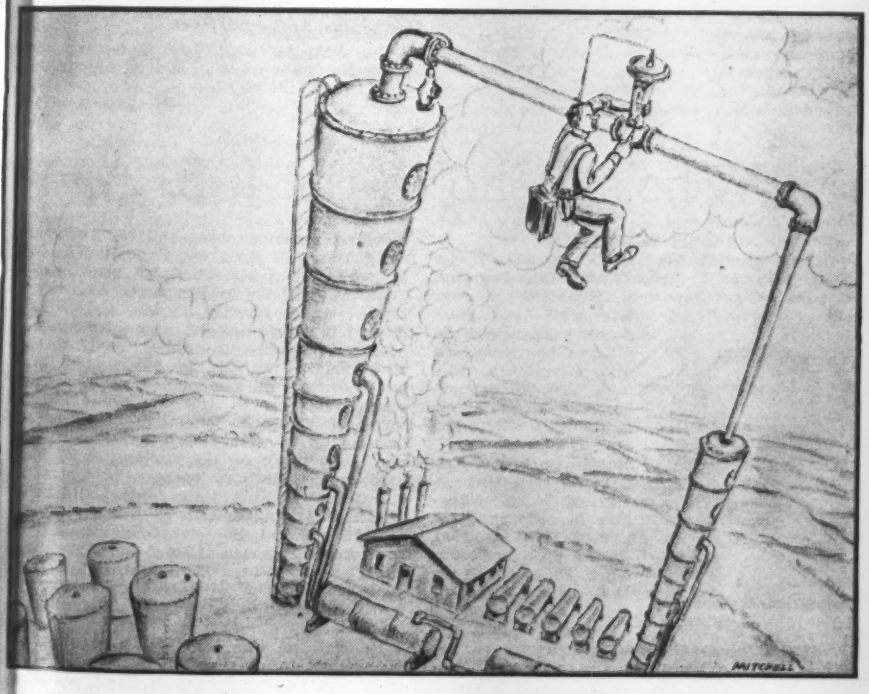
KANSAS CITY

May 27—Main Speaker: J. L. Cottrell, Pittsburgh Meter Division of Rockwell Mfg. Co. Subject, "Orifice Meters and Their Installations." Quiz Kids and Basic Lecture.

June 24—Main Speaker; W. R. Gibson, Trans-World Airlines. Subject, "History, Theory and Use of the Aircraft Compass—its Compensation for Deviation and Variation." Basic lecture by Jack Blackburn, Minneapolis-Honeywell Regulator Co.

July and August tours of industrial plants to be announced later.

—W. A. REICHOW, *Corr.*



"This oughta qualify me for aircraft instrument mechanic!"

NEW JERSEY

Sid Baran's second attempt to interest the electrical instrument people of Northern New Jersey in the I.S.A. produced an interesting meeting; however, they were again conspicuous by their absence. L. G. Gitzendanner of General Electric Company at Schenectady, spoke on "Electronics in Measurements." He explained in an interesting manner how electronics enable us to make measurements easier, faster, and in many cases more accurately.

The regular May meeting presented Bruce Irwin of Hammel-Dahl Company. Mr. Irwin compared the various types of control valves available and gave some very practical rules and illustrations of their proper application. The meeting was followed by a social period when refreshments were served. The fact that members of the Arrangements Committee had difficulty providing chairs to handle the unexpectedly large crowd is evidence of the meeting's success. Undoubtedly, the success of the social period after this meeting will insure its revival at some of the meetings next year.

The trip to Calco Chemical Company at Bound Brook on June 3rd will wind up the year's activities until September when we hope to have a large group in attendance at the Second Annual Instrument Conference in Chicago.

Harold McCarthy of Standard Oil Development Company will take over the job of Publicity Chairman for the coming year.

—GEORGE R. FEELEY, *Corr.*

NEW YORK

The Forty-ninth meeting of the New York Section was held at the Men's Faculty Club, Columbia University, on Monday, April 28th. A short business meeting was opened at 8:15 p. m. with the reading of the minutes of the previous meeting. Announcement was made that the topic of the May meeting would be "Relays" and that arrangements are being made for a field trip in June. Professor Carl Kayan presented a brief report on the Spring Meeting in Cleveland.

The speaker of the evening, George A. Hall, Jr., of the Bristol Company, Waterbury, Conn., was introduced by President Hildenbrand. The topic which Mr. Hall discussed, "Instrumentation Behind the Iron Curtain," was a factual report of some of his own experiences while in Russia as an engineer for the U. S. Military Supply Commission to the Soviet Union, Ford Motor Tire Project.

Mr. Hall opened his talk by saying that the plant was shipped to Russia to make replacement tires for lend-lease equipment, this being considered more economical and space-saving than sending the tires. The plant was complete in every detail and had been in operation for several years in this country. The problem was to reassemble the plant and put it in operation in Russia.

The principal difficulties encountered stemmed from lack of training, carelessness and a general attitude of "so what?" Some of the incidents mentioned were:

1. Separation of identification from equipment and consequent confusion.
2. Damage to equipment during trip by freezing and general mishandling.
3. Gross mishandling of equipment while unpacking and assembling.
4. Use of wrong material in assembly of plant, such as using electrical conduit on air and steam pressure lines.
5. General lack of respect for accurate and sensitive equipment, instruments and tools.

Separate incidents were given to illustrate each point. Each would have been quite humorous except for the tremendous waste and damage involved. Mr. Hall concluded by giving several incidents of general conditions encountered in Moscow.

—CHARLES D. COREY, *Sec'y.*

NORTHERN INDIANA

The May 19th meeting of the Northern Indiana Section was in the form of a social evening for members and guests and their wives and sweethearts. The affair was held at Tieble's, south of Hammond, where forty

persons enjoyed an excellent chicken dinner served family style. Dinner music was provided by a small orchestra.

Following dinner, A. Francis of Hammond showed reels of colored movies taken on one of his recent trips—a three months' trip through Canada and Alaska. Many of the shots were of flowers, with some particularly good scenes taken during the annual Rose Festival in Portland, Oregon.

Following the movies, and after a short recess, the rest of the evening was given over to music and dancing. Altogether it was a very enjoyable evening for all those present.

—EDWARD L. WHITE, *Corr.*

OAK RIDGE

The regular May 7th meeting of the Oak Ridge Section featured H. A. Straus of Monsanto Chemical Company, Oak Ridge, Tenn., as guest speaker. The dinner portion of the meeting started at 7:00 p. m., followed by the business and technical meeting.

The business meeting was called to order at 8 o'clock by President A. V. Novak, and the minutes of the last meeting were read by Secretary A. H. Fowler. Reports by committee chairmen were given, and N. L. Isenhour, National Delegate, spoke briefly concerning the Cleveland meeting. T. G. Dry, Chairman of the Membership Committee, spoke briefly concerning a drive for new members, and announced that two forum meetings were scheduled to be held in addition to the regular monthly meeting. The subjects to be discussed are "Triode Tubes" and "Flow Calibration." These forums will be conducted by J. R. Mahoney and G. R. Jamieson.

The speaker of the evening was introduced by the Chairman of the Publicity Committee, Charles W. Covey. The subject of Dr. Straus' talk was "Servomechanisms." The lecture was well illustrated with diagrams, sketches and graphs on the blackboard, and was opened by a brief explanation of how anti-aircraft and radar fire-control equipment using servomechanisms was used to bring down enemy planes in great quantities. A basic servo-mechanism was shown on the board and the component parts discussed. At the conclusion of the talk Dr. Straus answered informal questions from the floor.

V. D. Hauck, Chief Engineer of the Friez Instrument Division, Bendix Aviation Corporation, will speak at the June meeting on "Radiosondes."

A seminar session including three or four members of the Oak Ridge Section as speakers will be the program of the July meeting.

At the conclusion of the meeting, C. W. Covey, on behalf of the Program Committee, spoke briefly on the difficulties encountered in securing speakers and papers which will interest all classes of members. It was pointed out that the Program Committee could cope with the problem more satisfactorily if more constructive comments and criticisms were forthcoming from the members themselves, and greater cooperation and membership participation in the affairs of the Society was urged.

—CHAS. W. COVEY, *Corr.*

PHILADELPHIA

The Philadelphia Section held its monthly meeting on April 16th at the Penn-Sheraton Hotel, with over 100 members and visitors present. An innovation at this meeting was the display of new developments in instrumentation by several instrument manufacturers. The consensus of the group was that this type of display is beneficial to instrument men from an educational standpoint, being in line with the Society's plan for advancing instrumentation by educating the members.

Prior to the main topic of the evening we were fortunate to hear William Weber, Instrument Engineer for the Standard Oil Company of Aruba, present a short discussion of the instrumentation at the Aruba Refinery.

The arranged talk for the evening was handled very capably by Paul Wing of the Mason-Nielan Regulator Company. He discussed in detail the displacement-type level controller, comparing it with the buoyancy (or "kidney") type controller and pointing out the advantages of the torque-tube transmission unit, manual reset features and adjustable proportioning band incorporated in the displacement-type instrument.

The evening was "topped off" with refreshments for all.

The 47th meeting of the Philadelphia Section is scheduled for Wednesday, May 21, with Willard N. Greer, Leeds & Northrup Company, as speaker. His subject is to be "Industrial Electrochemical Measurement and Control."

The Social Event of the year, the I.S.A. Annual Dance, is scheduled to be held on June 27th at the Whitemarsh Country Club.

—STUART H. ROGERS, *Corr.*

ST. LOUIS

The regular April meeting of the St. Louis Section was held in the Ball Room at the Hotel York on Monday, April 28. Total attendance was 75, with 45 attending the dinner.

A vote was taken on the changes in the Constitution of the St. Louis Section to bring it into conformity with the National Constitution, and the changes were unanimously approved. The closing date of the Papers Contest was extended to May 19th, and the prizes will be awarded at the May 26th meeting.

The speaker of the evening was Lou Gess, Manager of the Sales Application Engineering Department of Brown Instrument Company, who spoke on "Flow Metering." Mr. Gess outlined the early history of flow meters and then went on to some of the newer designs. He also discussed factors that cause inaccuracy, such as dirt on orifice plates, air pockets in meter lines, dirty meter body surfaces, inaccurate location of taps at the orifice, difference of level of reservoirs in steam metering, etc. The importance of regular lubrication of pressure tight bearings was also stressed.

Mr. Gess stated that the first patent granted on a flow meter of the differential type was dated 1882, and that most of the early work was done in the Pittsburgh Natural Gas district, on gas flow. The first differential unit was a pitot tube, and it was used to bill gas customers. Accuracy was checked against discharge into gas holders.

The talk was illustrated with slides, and was very interesting and well received.

New officers of the Section, elected to serve for one year beginning June 1, 1947, are as follows:

Chairman: Orland G. Forcade, Shell Oil Company.

Vice-Chairman: Landon C. Lodge, Geo. S. Mepham Corp.

Secretary: Wm. G. Lee, Na[illegible] Co.

Treasurer: Roy Finch, O[illegible] Glass Co.

Program Committee Chairman: E. O'Brien, O'Brien Equipment Co.

Membership Committee Chairman: K. Welch, Leeds & Northrup Co.

Delegate: As before, W. E. Bo[illegible]

Journal Correspondent: Retiring Secretary, H. E. Zeffren.

The May 26th meeting is to be a social evening, including a cocktail hour at 6 p. m., dinner at 7, a short business meeting featuring the introduction of the new officers and an entertainment program at about 8:30. Refreshments will be served at the floor show.

—H. E. ZEFFREN, C[illegible]

WASHINGTON

The April meeting of the Washington Section was held at the Potomac Electric Power Co. Auditorium at 8:00 p. m., Monday, April 21st.

The guest speaker was Charles A. Packard, Chief Engineer, Struthers-Dunn, Inc. Mr. Packard's subject was "Electrical Operation of Small Mechanisms."

The speaker's knowledge and experience in the field of relays and other electrically operated mechanisms, combined with a sense of humor, made his talk both interesting and informative.

Demonstrative equipment and slides and wiring diagrams were used to augment the talk.

Considerable interest was shown by the group in the sample equipment and special applications of relays and other mechanisms.

—G. M. ROLLS, Co[illegible]

WAYNE COUNTY

The May Meeting of the Wayne County Section was held on May 19th at the First Presbyterian Church in Wyandotte, Michigan.

The meeting was opened with the drawing for the door prize, which was won by G. E. Flower. After a short business meeting, a film, "Synthetic Jewel Bearings" was shown.

The speaker of the evening was T. J. Cohen, President of the Taco-West Corp., who spoke on "Electronics as Applied to Liquid Level Control." Mr. Cohen gave a very interesting talk on all the various types of electronics and electrical control as applied to liquid level.

Our June meeting, date to be announced later, is scheduled to be a trip through some local industrial plant.

—W. G. BAKER, Co[illegible]

Who's Who in the I. S. A.

DR. R. H. MUNCH

Ralph Munch, I.S.A. Vice President, was born May 5, 1911 at Lafayette, Indiana, but he did not remain a "Hoosier" for long.

His grade school days were spent in Danville, Rockford and Monmouth, Illinois, and he attended high school in Monmouth, Chicago and Chapel Hill, North Carolina. Entering the University of North Carolina in 1927, he was graduated in 1931 with a B.S. in Chemistry. He received his M.S. in Chemistry also from North Carolina in 1932, and almost immediately started working for his Ph.D. at Northwestern University, Evanston, Ill.

By doing laboratory glassblowing, by a teaching assistantship, and by working [illegible] the Century of Progress Exposition in 193[illegible] Ralph financed his scholastic work and obtained his Ph.D. in Physical Chemistry in 1935. He very shortly became a Rockefeller Research Assistant at the University of Chicago, working on application of spectrophotometric methods to biochemical problems. In 1937 he accepted a position as research chemist in the St. Louis Laboratories of Monsanto Chemical Company, and has remained with that organization since. His work there on the application of physicochemical methods to process control led to interest in automatic control and industrial instrumentation.

Ralph joined the St. Louis Society for Instrumentation in 1944, and that same year was appointed Contributing Editor for *Industrial and Engineering Chemistry*, for which publication he writes a monthly column on Instrumentation.

In 1945, he was elected a member of the Executive Committee of the St. Louis Society for Instrumentation, and acted as delegate for this group at the Octobe[illegible]

1945) Pittsburgh meeting prior to the formation of the Instrument Society of America. In 1946 he was elected Chairman of the St. Louis group, which had become the St. Louis Section of the I.S.A., and in September of that year he was elected a Vice-President of the National organization. He is also chairman of the Publications Committee. His Chairmanship of the St. Louis Section has only recently expired.

Ralph is a member of the American Chemical Society, an associate member of the Optical Society of America, and a member of the Executive Committee of the A.I.A.S. Chemical Research Conference on Instrumentation for 1947 (formerly the Gibson Island Conference).

In 1935 Ralph married Charlotte Erwin of Kenilworth, Illinois, and they make their home at 303 Planthurst Road, Webster Groves, Mo. Five children, including twins, are Ralph's pride and joy—John, 9; Mary, 6; Ralph, 4; and Charles and Charlotte, 1½. With all the activity around the Munch home, there isn't too much time left for Ralph to putter around with his hobbies, metal working and glass blowing, but he does manage to enjoy some reading once in a while.

WILLIAM E. BOYLE

"Bill" Boyle, St. Louis Section Delegate, can almost be considered one of the "old-timers" in the instrument field, but with all his accomplishments he was much too modest in the information he submitted to Ye Editor for this little sketch. A little prodding brought out the following facts, however, and even if he won't say how old he is, it can be proven that he has led a full and useful life to date.

Bill's formal education includes Pre-Mining Engineering at Regis College, Denver, Colorado, some special tutorage in Mineralogy, and Metallurgy at the University of Southern California. Among his activities since then, he installed heat treating equipment and organized an instrument department for Consolidated Aircraft; was Instrument Engineer for Gramps Oil and Refining Company of Colorado and New Mexico; was Motor Supervisor for the Denver and Rio Grande Western Railroad; and Mining Engineer for the Colorado Fuel and Iron Company. His mining experience at that time included Carnotite operations in Colorado—this being one of the sources of uranium during the last war.

For the past four years Bill has been employed by the Shell Oil Company as Instrument Engineer, having gone to St. Louis from California to start the instrumentation on Shell's catalytic cracking units. On February 1, 1947, he was appointed Assistant Master Mechanic at the Shell Oil Company refinery at Wood River, Illinois.

Not only as Delegate, but also in other capacities, Bill has been very active in the St. Louis Section for several years. He has held the offices of Vice-President and President of the Section; he was President when the local society became a charter member Section of the I.S.A. When his term of office as President expired, he was elected Delegate to represent the St. Louis Section on the Board of Directors. Bill is a member of the Recommended Practices Committee and of its sub-committee on Thermocouple and Extension Wire Standards.

Bill is a member of the A.S.M.E. and is a Registered Professional Engineer in the State of Illinois. He is married and has three children, two girls and a boy. His son, Bill, Jr., is now attending St. Louis University.

Hobbies? Yes—archery, golf, fly-fishing for mountain trout (when he can get to a stream) and inventing. Bill secured claims on a selenium cell which was the fore-runner of present-day photo-cells, and is a co-owner with T. J. Maloney of a patent on a slide-valve gasoline engine. But, says Bill, with all his inventing, his hobbies, and even his recent promotion, his first love (outside of his wife and family) is and always will be Instrumentation and Control.

The St. Louis Section may well be proud of its Delegate who, in the person of Bill Boyle, has the interests of the Society, its members, and of instrumentation itself at heart.

F. H. TRAPNELL

F. H. Trapnell, Chairman, Recommended Practices Committee, has been in instrument work almost 100 percent since his graduation from the Virginia Military Institute in 1931 with a B.S. degree in Chemistry. Before and immediately after graduation he worked as Sanitary Engineer with the West Virginia State Department of Health, but shortly after joining the DuPont Company in 1932 he was made Assistant Instrument Superintendent at the Belle, W. Va., plant. This position he held until 1941.

"Trap" became involved in considerable instrument design and installation work for the various Ordnance Department plants prior to and during the early part of the war. This soon led to an assignment to Manhattan District work on projects for which DuPont was responsible. The instrument design engineering required on these projects was "Trap's" job and responsibility. He spent an entire year at the Hanford, Washington plant in charge of instrument installation.

"Trap" is now in charge of the Instrumentation Section of the Design Division of DuPont's Engineering Department, and carries the title of Instruments Engineer. He has served on the Applications Committee of the Industrial Instruments and Regulators Division of the A.S.M.E. for the past five years. He also served as Vice-President of the Philadelphia Section of the I.S.A. in 1946. He is now serving as Chairman of the highly important I.S.A. Recommended Practices Committee, and has organized this group into a smoothly functioning unit with several sub-committees and many projects under consideration. A semi-official report of the activities of this committee will be found elsewhere in this issue.

"Trap" is married and has one child, a daughter five years old. The family lives in Wilmington, Delaware.

ISA EMPLOYMENT REGISTER

WHEN: Second Annual Conference and Exhibit of the Instrument Society of America, September 8 through 12, 1947.

WHERE: Hotel Stevens, Chicago, Illinois.

Seeking a Position in Instrumentation? Registration forms and further instructions may be obtained from the Society Office. Pre-registration by applicants is advisable, as records will be made available to prospective employers before the week of the Conference and Exhibit.

Do You Need An Instrument Man? Companies or institutions seeking instrument men are requested to file notice of open positions prior to the week of the Conference and Exhibit so that qualified applicants may be selected for interview.

Interviews Arranged. Representatives of employers and applicants attending the Conference are urged to report to the office of the EMPLOYMENT REGISTER immediately upon arrival so that interviews may be arranged.

The Instrument Society of America, 1117 Wolfendale St., Pittsburgh 12, Pa.

ISA EMPLOYMENT SERVICE

In printing these announcements the Society assumes no obligation as to responsibility of employers. Those replying to announcements should include two copies of their reply. When testimonial documents are to be included, copies of such documents and *not* the originals should be sent. The Society regards acknowledgment by employers of all applications as an act of courtesy but can assume no responsibility for their failure to do so. Address all replies to Employment Committee, Instrument Society of America, 1117 Wolfendale St., Pittsburgh 12, Pa.

—C. F. GOLDCAMP, *Chmn. Employ. Com.*

SITUATIONS OPEN

GRADUATE ENGINEER for electronic and industrial instrumentation in large research laboratory. Considerable practical instrument design and application experience is required. Must be capable of working with and handling technical personnel. Work includes instrumentation application and control in the fields of physics and chemistry. Location, Knoxville, Tenn. Applicant eligible for local area housing. Box 54.

PHYSICIST OR ENGINEER, MS Degree for responsible position and fundamental electronic instrument research design and development in a large research laboratory. Considerable electronic design and experience is required. Must be capable of handling and directing technical personnel. Work includes design of instruments for the detection, measurement and control of physical properties in the fields of physics and chemistry. Location Knoxville, Tenn. Applicant eligible for local area housing. Box 55.

ENGINEER—young graduate familiar with instrument sales and having experience in the instrument field, to sell rotameters and flow indicators in Chicago territory. Box 56.

GRADUATE ENGINEER experienced in the design, manufacture and application of precision pressure regulators and other power plant specialties. Location Chicago and Springfield, Illinois. Box 57.

ENGINEER, recent graduate, degree in mechanical engineering preferred, who is interested in becoming familiar with the industrial instrument field, to handle test work of development and design of regulators and allied products. Location, Chicago. Box 58.

INSTRUMENT MECHANIC by large process manufacturer to service automatic boiler controls, recorders, flow meters; temperature recorders on dryers, cooking kettles and kilns. Must be able to make efficiency checks throughout plant. Salary $250.00 per month. Location Southern Illinois. Box 59.

INSTRUMENT MECHANIC for maintenance and repair of all types of oil refinery instruments including flow controllers, temperature regulators, etc. Hourly basis. Permanent. Location Kentucky. Box 60.

SALES PROMOTION ENGINEER. Leading manufacturer of industrial instruments has unusual opportunity for graduate engineer experienced in the pulp and paper or textile industries; or one with knowledge of process control instrumentation who is interested in applying this knowledge to these industries. Work consists of process control engineering, writing of quotations, order follow-up, and sales correspondence with branch offices and customers. Some traveling involved. Reply giving complete details of experience, education and personal history. Box 61.

Technical Society News

BLOWING-TUBE LIQUID-STEEL PYROMETER

"The blowing-tube pyrometer has a true blackbody temperature scale and a nitrogen bubble at the end of the tube in the liquid steel also appears to closely approach a blackbody radiator," declared L. O. Sordahl and J. W. Bain, of the U. S. Steel Corp.'s Research Laboratory, Kearny, N. J., before the American Institute of Mining and Metallurgical Engineers, Cincinnati, Ohio, April 23. Since a furnace melting chamber under certain conditions also approaches a black body, they stated, the same calibration setting will give true temperature in any such blackbody radiator and also down in the steel bath, if a neutral gas such as nitrogen is used for purging the tube. With normal air purging, oxidation causes an error which increases linearly from a negligibly small value at about 2600°F., to about 65°F. at 3000°F. true temperature. This error appears to be consistent, however, for a normal range of air pressure on the blowing-tube. Furthermore, optical pyrometer readings on most of the common grades of carbon steel appear, strangely enough, to deviate from true temperature in very nearly the same manner. The evidence indicates that the usual effective emittance for open streams (red radiation, 0.65 micron) increases from about 0.40 at 2600°F. to about 0.50 at 3000°F., causing average optical readings corrected for the usual assumed emittance of 0.40 to deviate from the true temperature in nearly the same manner as that for the blowing-tube.

Drs. Sordahl and Bain said that as long as the correction to an optical pyrometer reading on liquid-steel streams in the open remains based upon the accepted average emittance of 0.40, there would seem to be no need to apply the correction for air purging on the blowing-tube temperatures. Present data indicate that bath temperatures by thermocouple and blowing-tube measurements, if corrected to true temperature, will be from 35 to 65°F. low as compared to the tapping or pouring temperature scale now used in most steel plants. This poses a problem for general consideration, since there are a few advantages in the use of a true scale of temperature.

CONTROL ENGINEERING COURSE TO BE GIVEN AT CORNELL

A course in Control Engineering is to be given in the fall term at Cornell University's Sibley School of Mechanical Engineering by C. R. Otto, Assistant Professor, Engineering Materials Department. A general outline of this course follows:

3670—Control Engineering. Either term. Credit three hours. Prerequisite or parallel course: 3X40 and CE6, or equivalents. C. R. Otto.

Two lectures and one laboratory each week. A survey of the commercially-available automatic controliers commonly used in current industrial practice, as to construction, installation requirements and the patterns of control that are available. The problems existing in various plants and processes will be discussed, and the influence of the control modes on process behavior will be studied.

1. *Measurement systems* — Primary elements, signal transmission, response to dynamic variables, installation details.
2. *Processes*—Elements of typical systems, lags, response to upsets, sources of load variations.
3. *Controllers*—Modes of control available, construction and functioning, adjustments.
4. *Final Control Elements*—Positioners, construction, characteristics, installation.
5. *Auxiliaries* — Gage boards, air and electrical systems, remote indications.
6. *Applications*—Actual installations will be inspected and discussed as much as possible throughout the course.

RADIO CLUB DISCUSSES MEGACYCLE METER

The May 9th meeting of the Radio Club of America featured a paper, "The Megacycle Meter," by J. B. Minter, Chief Engineer of Measurements Corp., describing a high-frequency development of the "grid-dip" meter into a compact multi-purpose instrument, which was demonstrated.

TEXAS A&M's COURSE

The Agricultural and Mechanical College of Texas will conduct its second annual short course in "Instrumentation for the Process Industries" at College Station, August 27-28-29.

The course is outlined on an Engineering level. The speakers scheduled for this year's session will be drawn largely from operating companies. Last year's course, in spite of a delayed start, was attended by more than 200.

Further information can be obtained by writing to Dr. P. G. Murdoch, Engineering Dept., A. & M. College, College Station, Tex.

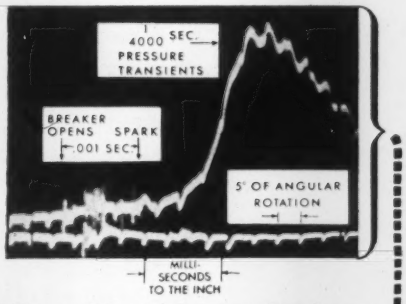
VISITORS.—Plant tours and dinner discussi with prominent business leaders have been ar ated for groups of foreign students attend Rensselaer Polytechnic Institute, by W. & L. Gurley of Troy, N. Y. On May 5 and 6, Chinese students were the first group invited see the Gurley plant, after a dinner at the Club where they heard addresses by Z. T. Ts and Sidney Tsai of the Chun Ho Co., agents the Gurley scientific instruments in China.

WHEN A FELLER NEEDS CONTROL BY Putt

BLANK WIDGET CO.
SWAMP COUNTY WORKS
TRICK INSTRUMENT CO.
FRIDAY
BIG CITY
DEAR BILL
THE BIG BOSS IS COMING DOWN HERE NEXT WEEK. THIS IS A GOOD CHANCE TO SHOW HIM YOUR NEW INSTRUMENT.
RUSH DOWN HERE WITH A COMPLETE WORKING SAMPLE AND WE'LL INSTALL IT SO HE CAN SEE WHAT IT WILL DO.
DON'T FAIL TO GET HERE ON MONDAY. I AM COUNTING ON YOU.
SINCERELY,
SUPERINTENDENT
SWAMP A.R. CO.
AMP JUNCT.
GEE BILL - I FORGOT TO LET YOU KNOW. TH' BOSS DECIDED NOT TO COME DOWN 'TIL NEXT MONTH
Putt
IDEA BY: JACK HALLOWELL, PITTSBURGH, PA

Instruments pays $5.00 for each idea used. Sender's name and company affiliation will be acknowledged in the cartoon unless we are specifically requested not to do so. Address Cartoon Dept., *Instruments*, 1125 Wolfendale St., Pittsburgh 12, Pa.

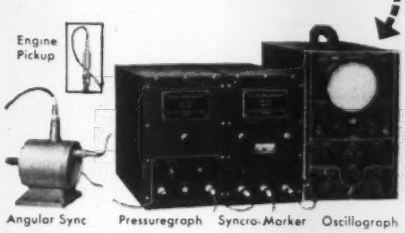
Have you ever seen the INSIDE of an EXPLOSION?



SEEING NOW MADE POSSIBLE BY REMARKABLE NEW ELECTRONIC FEATURES, EMBODIED IN

PRESSUREGRAPH with Syncro-Marker

produces on oscilloscope screen, accurate picture of pressures during and after explosion, relates pressure variations to time, top dead center, angular velocity, etc. See pressure-time characteristics of automotive, jet and Diesel engines, also compressors, pumps, etc. Operates over range from static up to 10,000 cycles at pressures from 0 to 10,000 lbs.



Send for description and full engineering data

ELECTRO PRODUCTS LABORATORIES
549 W. RANDOLPH ST., CHICAGO 6, ILL. *Phone STAte 7444*

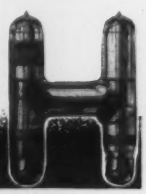
ACCURACY OF TEMPERATURE CONTROL DETERMINES ITS QUALITY

ACCURATE control of temperature or pH is vital to modern heat treating or chemical processing, because only in this way can uniform quality be obtained under mass production conditions.

Potentiometers have made such control possible, and "the heart" of these instruments in most cases, for over 25 years, has been the Eplab Standard Cell. This cell is a "yardstick" for the translation of voltage to temperature. The first commercial cell of its type, constant research has made it "as standard as sterling".

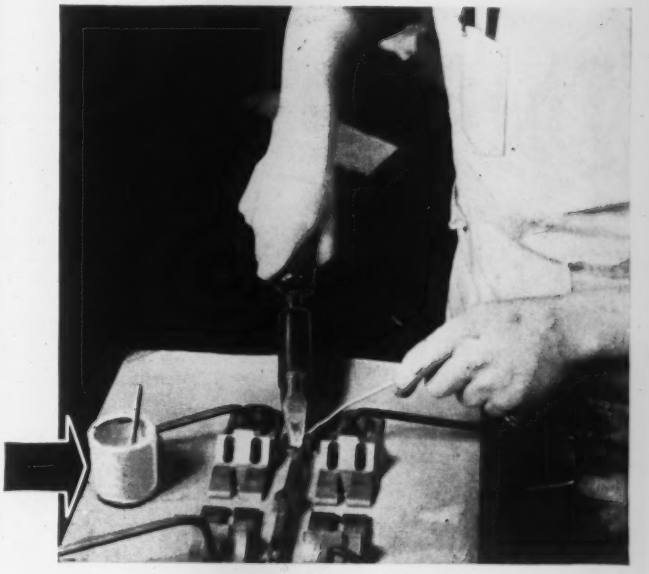
When you buy potentiometers, specify Eplab Standard Cells.

THE EPPLEY LABORATORY, INC.
SCIENTIFIC INSTRUMENTS • NEWPORT, R. I., U. S. A.



EPLAB Standard Cells For Potentiometric Instruments As Standard as Sterling

A KESTER FLUX
for Every Soldering Job!



• For every soldering operation that requires a separate flux, there's a Kester Flux in the exact formula to do the best job. Kester Fluxes are laboratory tested, and manufactured to eliminate the risk of failure in any solder requirement.

• Nearly half a century of research in the laboratory and practical experience in the plants of industrial users have provided Kester engineers with the basis for the scores of flux formulas Kester manufactures for industry today.

• This huge fund of flux and solder knowledge is at your disposal. Write fully at any time for prompt assistance on any solder question. There is no obligation.

KESTER SOLDER COMPANY
4216 Wrightwood Ave., Chicago 39, Illinois
Eastern Plant: Newark, N. J.
Canadian Plant: Brantford, Ont.

KESTER
Solder Fluxes
STANDARD FOR INDUSTRY

MATCH UP with TRIPLETT Meters

METER HIGHLIGHTS

- FIVE BASIC MOVEMENTS—Electrodynamometer, moving iron, moving coil, thermocouple and rectifier types.
- RANGES—All standard ranges for every major instrument need.
- SIZES—2", 3", 4", 5", 6" and 7".
- STYLES AND FINISHES—Round, rectangular, square and fan; wide flange, narrow flange, flush, projection or portable. Available in molded or metal case.
- SPECIAL FEATURES TO ORDER—Rear illumination, special dials and other features available on most models.

Triplett
ELECTRICAL INSTRUMENT CO.
BLUFFTON, OHIO

Manufacturers' New Literature

In this department we report new literature pertaining to Instrumentation, received from the manufacturers. We urge readers to request ONLY those bulletins which will be of value to them. Use the Postage-free Order Card on page 581.

O-285 **Air Release Valves.** 8-page 8½" × 11" Bulletin No. 140 pictures and describes maker's line of air release valves for water, sewage and industrial use. Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia 42, Pa.

O-286 **Voltmeters.** 8-page 8½" × 11" Bulletins Nos. 28, 29, 31 and 32 picture and describe "Model VM-27" wide-range vacuum-tube voltmeter; "Model 31" high-voltage voltmeter; "Model 32" high-frequency electronic voltmeter; and "Model 29" high-frequency probe. Alfred W. Barber Laboratories, 34-04 Francis Lewis Blvd., Flushing, N. Y.

O-287 **Navigational Instruments.** 24-page 8½" × 11" Catalog W-2 pictures and describes maker's line of instruments for air and sea navigation. Weems System of Navigation, Annapolis, Md.

O-288 **Wire-wound Resistors.** 6-page 8½" × 11" Bulletin C-2 pictures and describes maker's line of power wire-wound resistors in fixed and adjustable types. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

O-289 **Gaging Tools.** 4-page 4" × 9" bulletin pictures and describes maker's line of gage blocks, thread plug gages, vernier height gages and vernier calipers. Jansson Gage Co., 19208 Glendale Ave., Detroit 23, Mich.

O-290 **Automatic Controllers.** 20-page 8½" × 11" Bulletin No. 3-6400 pictures and describes maker's line of electronic controllers including indicating millivoltmeter controllers, indicating resistance thermometer controllers, indicating potentiometer controllers, automatic fuel and power input controllers, automatic valve positioners, etc. Wheelco Instruments Co., Harrison & Peoria Sts., Chicago 7, Ill.

O-291 **Boiler Level Control.** 8-page 8½" × 11" Bulletin 467 is a case record of maker's instruments for boiler water level control installed at the Buzzard Point Plant of Potomac Electric Power Co. Northern Equipment Co., 1945 Grove Drive, Erie 6, Pa.

O-292 **Electrical Snap Gage.** 4-page 8½" × 11" Circular No. 941 pictures and describes the "Electrolimit" snap gage, a portable comparator for checking outside dimensions. Pratt & Whitney Div., West Hartford 1, Conn.

O-293 **Pyrometer Supplies.** 40-page 8½" × 11" Bulletin No. 100-1 is a buyer's guide of maker's pyrometer supplies including thermocouples, protecting tubes, thermocouple wires, lead wires and insulators. Brown Instrument Co., 4482 Wayne Ave., Philadelphia 44, Pa.

O-294 **"The Bodine Motorgram."** 4-page 8½" × 11" Vol. 27 No. 2 of this house organ contains an article on the application of maker's fractional-horsepower motors to high-precision color cameras for photoengraving. Bodine Electric Co., 2250 W. Ohio St., Chicago 12, Ill.

O-295 **Internal Micrometer.** 4-page 8½" × 11" Prospectus 140E pictures and describes the "Imicro" internal micrometer, available singly or in sets for measuring internal dimensions from 0.500" to 4.000". Maveg Machine Sales Association Inc., 24-16 Bridge Plaza South, Long Island City 1, N. Y.

O-296 **"General Radio Experimenter."** 8-page 6" × 9" Vol. 21 No. 10 of this house organ contains an article describing the development of radar countermeasures. General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

O-297 **Volt-ohm-milliammeter.** 32-page 5" × 7" booklet is an operator's manual for maker's "Model 260" volt-ohm-milliammeter. Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

O-298 **Heating Jackets.** 8-page 8½" × 11" Bulletin C-100 pictures and describes "Gyco" heating jackets for electrical heating of flasks, tubing, etc. Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

O-299 **Rheostatic Voltage Regulator.** 4-page 8½" × 11" bulletin pictures and describes the "Regohm" direct-acting rheostatic type automatic voltage regulator. Electric Regulator Corp., 191 Park Ave., New York 35, N. Y.

O-300 **Capacitors.** 16-page 8½" × 11" Catalog No. 76 pictures and describes maker's line of capacitors including molded tubular wax impregnated; metal-cased mineral oil grounded; bypass mineral oil impregnated; mica and silvered mica; etc. Sangamo Electric Co., Springfield, Ill.

O-301 **Radio Testers and Electrical Indicating Instruments.** 24-page 8½" × 11" Catalog No. 447 pictures and describes maker's line of instruments including tube and set testers, battery testers, oscillators, signal tracers, cathode-ray oscilloscopes, and panel type electrical indicating instruments. Supreme Instruments Corp., Greenwood, Miss.

O-302 **Transformers.** 4-page 8½" × 11" bulletin describes maker's facilities for manufacturing special types of transformers and pictures some specially engineered designs. Freed Transformer Co., 72 Spring St., New York, N. Y.

O-303 **Hydraulic Presses.** Single sheet 8½" × 11" pictures and describes maker's super high speed hydraulic presses available in several sizes with speeds varying from 50 to 100 1" strokes per minute. Wroble Engineering Co., 1067 Davis Terrace, Schenectady 3, N. Y.

O-304 **Vacuum Monitor.** 4-page 8½" × 11" bulletin pictures and describes the "Skanascope" high-vacuum monitor which indicates by means of color indications on a fluorescent screen the degree of vacuum attained. Distillation Products, Inc., Vacuum Equipment Div., 755 Ridge Road West, Rochester 13, N. Y.

O-305 **Decade Amplifier.** 2-page 8½" × 11" Bulletin B-4 pictures and describes the "Model 102A" decade amplifier, a general-purpose pre-amplifier having stabilized gains of ×100 and ×1000, and maximum gain of approx. ×10,000. Kalbfell Laboratories, 1076 Morena Blvd., San Diego 10, Calif.

O-306 **Smoke Detector.** 2-page 8½" × Bulletin No. 57 pictures and describes . 925" smoke detector which indicates presence of smoke or haze by employing the principle of reflected light m the smoke particles. F. W. Dwyer g. Co., 317 S. Western Ave., Chicago,

O-307 **Stationary Tachometers.** 4-page " × 11" bulletin pictures and describes maker's line of stationary tachometers with 6" dials. O. Zernickow Co., Park Row, New York, N. Y.

O-308 **Transverse Testing Machine.** 2-page 8½" × 11" Bulletin TT pictures and describes "Model TR-1" transverse testing machine of 10,000 lbs. capacity, 24" maximum span, and 4" opening. Steel City Testing Machines, Inc., 8843 Livernois Ave., Detroit 4, Mich.

O-309 **Parabolic Flume.** 8-page 8½" × 11" Bulletin No. 210 pictures and describes "Type S" parabolic flume for measuring open flows of water, sewage and industrial liquids. Simplex Valve & Meter Co., 68th and Upland Sts., Philadelphia 42, Pa.

O-310 **Input Controllers.** 2-page 8½" × 11" Bulletin T-49 pictures and describes maker's manually-adjusted input controllers for control of current input to electric heating elements in furnaces, ovens, etc. Automatic Temperature Control Co., Inc., 34 E. Logan St., Philadelphia 44, Pa.

O-311 **Audio Signal Synchronizer.** 4-page 8½" × 11" Bulletin No. 34 pictures and describes "Model J" audio signal synchronizer for the synchronization of signals from 2 to 100,000 cps. on input voltages as low as 0.05 volt. Televiso Products Co., 7466 W. Irving Park Rd., Chicago 34, Ill.

O-312 **Magnetic Dipping Needle.** Single sheet 8½" × 11" pictures and describes the "Di" magnetic dipping needle for locating iron and steel objects underground. Globe Phone Mfg. Corp., Reading, Mass.

O-313 **Electronic Supplies.** 160-page " × 9" Catalog 112 pictures and describes radio and electronic apparatus and components distributed by this company. Allied Radio, 833 W. Jackson Blvd., Chicago 7, Ill.

O-314 **Bimetal Thermostats.** 4-page 8½" × 11" Bulletin F-2000 pictures and describes "Type S" adjustable and non-adjustable bimetal thermostats for a temperature range of 0°F. to 650°F. Stevens Mfg. Co., Richland Trust Bldg., Mansfield, Ohio.

O-315 **Appliance Tester.** 2-page 8½" × 11" bulletin pictures and describes "Model 390" volt-amp-wattmeter for use in checking all types of electrical appliances. Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

O-316 **Power Analyzer.** 2-page 8½" × 11" Bulletin Form 6111 pictures and describes "Model 77" electrical power analyzer, a portable test instrument for a-c. power measurements. Niagara Electrical Instrument Co., 559 Ellicott St., Buffalo 3, N. Y.

O-317 **Instrument Panels and Cubicles.** 4-page 8½" × 11" bulletin pictures and describes maker's standardized line of panel units, cubicles and accessories. Falstrom Co., Falstrom Court, Passaic, N. J.

O-318 **Permanent Magnets.** 24-page 8½" × 11" bulletin lists permanent magnet materials and their properties, gives design considerations, and shows demagnetization and energy curves for several types of magnet materials. Arnold Engineering Co., 147 E. Ontario St., Chicago 11, Ill.

O-319 **"Black Light Beacon."** 4-page 8½" × 11" Vol. 3 No. 5 of this house organ contains several articles on appli-

SEEING UNLIMITED with the NEW PALMER *Thermometer*

● It looks as clear and bright as the desert on a sunny day—when you look at the new Palmer Thermometer. The new Extruded Brass Case plus famous "Red-Reading-Mercury" does the trick! You get a standard beautiful chrome finish at no extra charge . . . a full, easy-to-see scale with large, clear numerals, offering visibility never before available.

Other new features include "snap-on" cap, double strength, non-rattling glass, dustproof, fumeproof case. Write for new Bulletins 46-2 and 46-3 for full data.

AND REMEMBER—specify this new thermometer on original equipment purchased from your jobber or equipment manufacturer—there should be no extra charge!

PALMER THERMOMETERS INC.

In 7, 9, and 12 inch case sizes with chrome finish; in 4 and 6 inch sizes with nickel finish.

Mfrs. of Industrial, Laboratory, Recording & Dial Thermometers
2511 Norwood Ave., Cincinnati 12, Ohio
Canadian Plant: King & George Sts., Toronto 2

Here is your LITERATURE and INFORMATION order card

Instruments, 1117 Wolfendale St., Pittsburgh, Pa. *(June 1947)*

Please have the following catalogs, etc., reviewed in this issue sent to me.

Numbers .....

.....

.....

I desire further information on devices described in the "New Instruments" Dep't:

Numbers .....

.....

.....

I also desire further information concerning the following products advertised in this issue (Write page number and name of company)

.....

Name .....

Company..... Position.....

Co.'s Address.....

(OR) Home Address.....